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OPPORTUNISTIC MAINTENANCE ENGINE SIMULATION OMENS III.(U)
OCT 79 J L MADDEN , V L WILLIAMSON
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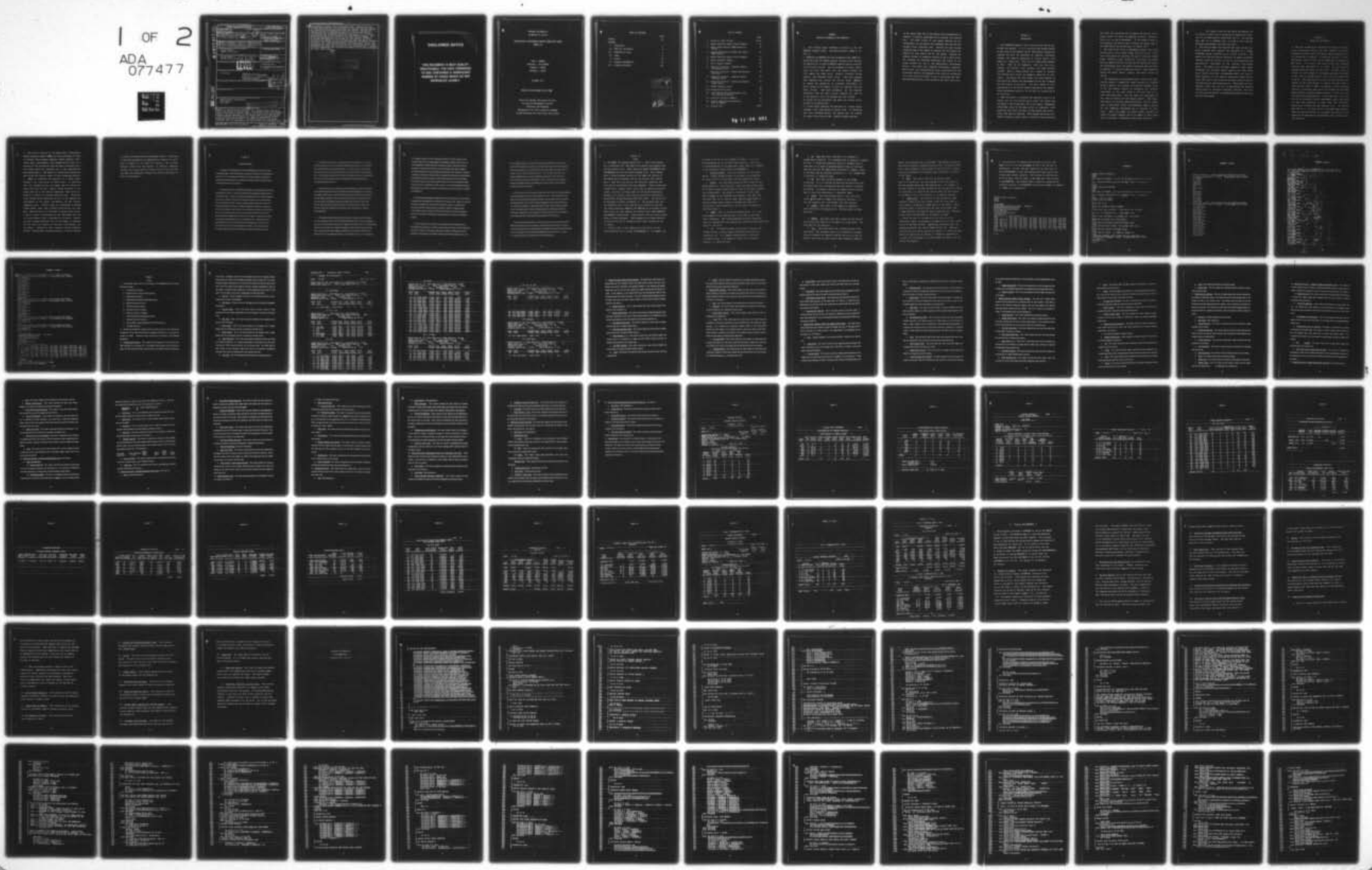

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OMENS III simulates the operation of a single engine through a very long period of future time. In operating over this extended period, the engine must be removed for repair from time-to-time. Repairs become necessary on the engine when one of the modules fails prematurely or whenever it requires replacement of an internal life-limited part. The model tracks all the engine removals and all replacements of each module and offending life-

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cont

limited part through future simulated time. Records are kept through simulated time of the number of removals and the reasons for removal for each module and for the engine. Reasons for removal include (1) premature failure of one or more parts, (2) reaching the scheduled operating time limit, or (3) being screened out due to the opportunistic maintenance policy. The model has improved and revised the earlier version (OMENS II) by adding the capability of screening individually by parts instead of by module, as well as separate base and depot screens. The model also computes maintenance, pipeline, parts costs, and transportation costs associated with the forecasted removals and aggregates the costs for any desired life cycle period (in years) to aid in selecting that optimal maintenance policy which produces the least total cost.

DISCLAIMER NOTICE

PROGRAM LAU/OMENS3,R

F100PW100 (F-15/16)

OPPORTUNISTIC MAINTENANCE ENGINE SIMULATION MODEL

OMENS III

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OCTOBER 1979

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SUMMARY

PROGRAM LAU/OMENS15S AND OMENS16S

1. This Working Paper documents revisions to the old OMENS2,R Computer Model. (See Working Paper, OMENS II 79-137-1.)

2. OMENS15S and OMENS16S are both documented under OMENS III, which describes the CREATE Computer Programs which simulate the operation of a single F100PW100 complete engine installed in an F-15/16 aircraft. The two programs are nearly identical, but have been split into two models because the F-15 engine has fewer parts, slightly different flying factors, and different factor rates. These new programs have improved and revised the earlier model, OMENS2,R by adding the capability of screening individually by parts instead of by module, as well as separate base and depot screens. The scale parameters are now computed internally from the input initial removals per 1000 FH of the modules, and a run program has been created to accept new run parameters and spawn and execute either program run automatically.

3. Either model simulates the operation of a single engine through a very long period of future time. In operating over this extended period, the engine must be removed for repair from time-to-time. Repairs become necessary

on the engine when one of the modules fails prematurely or whenever it requires replacement of an internal life-limited part. The model tracks all the engine remcvals and all replacements of each module and offending life-limited part through future simulated time. Records are kept through simulated time of the number of removals and the reasons for removal for each module and for the engine. Reasons for removal include (1) premature failure of one or more parts, (2) reaching the scheduled operating time limit, or (3) being screened out due to the opportunistic maintenance policy. The model also computes maintenance, pipeline, parts costs, and transportation costs associated with the forecasted removals and aggregates the costs for any desired life cycle period (in years) to aid in selecting that optimal maintenance policy which produces the least total cost.

Chapter I

Background

1. The F100PW100 engine in the F-15/16 aircraft can be subdivided into modules. It is a relatively new engine concept in that each of the modules can be individually removed and replaced and each can therefore be replaced, purchased, stocked, and repaired separately at various levels, each module as a single unit. There are six identifiable modules to date. They are the augmentor, inlet fan, fan drive, turbine, low pressure core, gearbox, and high pressure turbine. Each of these modules has a number of internal life-limited parts except the augmentor which has no life-limits. The engine has been broken into these modules to facilitate the removal and replacement actions and to manage the life-limits on the parts. The total number of life-limited parts in the entire engine affected by the opportunistic maintenance policy is 51 for the F-15 version and 54 for the F-16.

2. When the module is installed and operated as part of an engine, all the life-limited parts within that module age according to the flying hour rate of the engine. Management establishes limits on how many cycles (or sometimes, total operating time units) the parts in the modules may accrue before they must be replaced. This maximum operating time (MOT) is normally stated either in cycles or total operating

time (TOT) and converted into its engine flying hour equivalents within the model by applying actuarial conversion factors set by engine management. In the examples shown in this program, the factors were reviewed and agreed upon at the F100 Factors Review Meeting, 8-9 August 1979.

3. The life-limits cause a management problem since they usually are not set at equal values across the parts. After one or more parts are replaced, the ages of the parts become mixed. Whenever a part reaches its life-limit, the engine must be removed from the aircraft and the engine must be put into maintenance where the module containing that part must be removed. If the parts ages are mixed, a large number of engine and module remove, replace, and repair actions is caused.

4. The opportunistic maintenance policy states that whenever an engine is removed for repair because of a problem within a module, all internal life-limited component parts of all the modules should be considered for possible replacement at that time, based on how close they are to their individual MOTs. This may cause the replacement of more than one module for each engine removal. When component parts are replaced opportunistically, they no longer cause a near-future module (corresponding engine) removal for that component replacement due to reaching its life-limit. Thus, the number of future module removals for repair is greatly reduced, while the number of spare parts used is increased. Preliminary studies have shown that

the removal rates for the engine and modules can be reduced as much as 20 to 30 percent by appropriate selection of the opportunistic maintenance policy. See Working Note, XRS 77-7-1, November 1977, "A Study of the F-100 PW-100 Engine Maintenance and Build Policies."

5. This Working Paper will describe the logic and the computer programs that simulate the operation of a single F100PW100 engine installed in an F-15/16 aircraft. The models will provide long-run forecasts of engine and module removals caused by failure, as well as time expiration and opportunistic replacement of the internal life-limited parts. The models also calculate composite (both usage, scheduled, and screened) engine removals per 1000 flying hours factors and their corresponding NRTS rate factors. These forecasts will be based on appropriate input failure rates, MOT limits, and screening intervals being tested for the opportunistic maintenance policy. These models are considered a major tool for use in determining the expected effectiveness of alternate screening intervals, and their use will help the analyst in establishing effective policies for the F100 engine.

Chapter II

Needs for the Models

1. When the attempting to establish an effective opportunistic maintenance policy, one must determine how given screening intervals affect the future repair frequencies for the engine and its modules. A screening interval is a predetermined, definite time period immediately preceding an MOT limit. If a part's age falls within the screening interval when the module is in repair, the part will be removed opportunistically at that time. In other words, if the part is close enough to its maximum operating time (MOT) at the time of a module repair, then it will be removed and replaced. This opportunistic action will preclude the later removal of the module merely to replace this part when it would finally reach its MOT. In general, as the screening interval is increased, more parts are screened out with each module removal and fewer module removals in total will occur over the given program period. At the same time, there will also be an increase in parts replacements since they would not have been permitted to reach their full lifetimes, having been screened out and replaced early. See Working Note XRS 77-7-1, "A Study of the F-100 PW100 Engine Maintenance and Build Policies" for a graphic description of the impacts of an opportunistic maintenance policy using screening intervals.

2. The F-15/16 versions of the Opportunistic Maintenance Engine Simulation model--OMENS III--were developed in order to forecast future engine removals, module removals, individual parts replacements, and transportation costs as a function of the alternative base and depot screening intervals being tested for possible use in the opportunistic maintenance policy. The models are calculators helping the user assess the probable impact of each screening interval.

3. OMENS III simulates the operation of a single engine through a very long period of future time. In operating over this extended period, the engine must be removed for repair from time-to-time. Repairs become necessary on the engine when one of the internal components either fails prematurely or reaches its maximum operating time. The models track through future simulated time all of the removals and replacements of the engine, the modules, and the internal component parts. Failure times are determined by making random number draws from lifetime distributions for each part. When new parts are installed to replace removed ones, a time to failure is determined for the replacement part and its future removal time is scheduled in the model. Records are kept through simulated time on the number of removals and the reason for removal for each part, each module, and the engine. Reasons for parts removals include premature failure, reaching MOT, reaching tolerance, or being screened

out due to the opportunistic maintenance policy. (Tolerance is the name assigned to an opportunistic removal of a part when it appears to be close to a failure. The aircraft mechanic would have the ability to identify impending failure of a certain portion of parts even if they were not near MOT, nor prematurely "failed" but worn and therefore in need of replacement.)

Chapter III

Computation Logic

1. Programs LAU/OMENS15S, R and LAU/OMENS16S, R are Monte Carlo simulation models. They both produce removals per 1000 FH for their respective aircraft (F-15, F-16) engines and modules, man hours expended, maintenance analysis and pipeline costs for the engine and modules, NRTS rates, parts costs, transportation costs, and total costs.

2. The main purpose of the OMENS III programs is to calculate when in future simulated time each part will drive a module (and consequently engine) removal to replace the part. The part which fails or reaches its life limit is then replaced after making suitable records of the removal, and the time until next removal for the replacement is determined by making a random draw from the time-to-failure distribution for that part. While the engine (or module) is in repair, all of the other modules (or parts) which have not failed are screened to see whether they are close enough to their maximum operating time (MOT) limits so that it is economical to replace them at this time. If a part is screened out, records are updated recording which part was replaced and why, a replacement part is then installed and its time to next failure is established by a random number draw exactly the same as was done above for a failure. The removals of the next higher assembly module and/or engine are also recorded by the model.

3. The model maintains two counters for each life-limited part. One counter, JTTF(J), keeps track of time remaining (in flying hours) until part J is forecasted to be removed because of premature failure. The other counter, JTTL(J), keeps track of how much time remains until part J would reach its maximum operating time. The maximum operating time is stated in the input in either total operating time units or in cycles both of which are converted to engine flying hours by an actuarial conversion factor.

4. The simulation clock is advanced in the following way. After all the failure times (JTTF(J)'s) and MOT times (JTTL(J)'s) have been established for all J parts, the program finds the minimum JTTF(J) and the minimum JTTL(J), and the lesser of these values is selected. This is the time until the next most imminent event. The next steps in the program determine whether this minimum occurs in the current report period and whether on one or more than one part. That is, will there be multiple part failures, and will they occur in the present or a future reporting period?

5. Following the determination of the next most imminent event, this amount of time is subtracted from every JTTF(J) and JTTL(J) and from the time remaining until the end of the report period, and it is added to the system clock. The subtractions are done for one J part at a timeand the addition is done once per engine removal. After all the parts have been updated, reasons for the removals of the parts are determined. If a part failed prematurely, it is classified into one of two categories:

(1) a usage removal if its time remaining until MOT, JTTL(J), is greater than its base screen or (2) a U-Dep (usage to be repaired at depot) removal when its time remaining until MOT,JTTL(J), is less than or equal to the base screen for that part. If a part did not fail but its time remaining is less than or equal to its tolerance interval, it is also considered as a failure and is removed. Tolerance removals are those part removals that are expected to be detected by maintenance personnel because they are about to fail and some symptom will be noticeable. If JTTL(J) is equal to zero, this means that there is no time remaining until MOT and the removal is classified as an MOT removal. If the time remaining is greater than zero but is less than or equal to the base screen interval, the part is classified as screened out.

6. Following the appropriate tabulations of the removal of part J, the modules containing the offending parts are identified by removal codes. There is a hierarchy involved in multiple parts removals from the same module. If multiple parts are removed, all for usage reasons, the module is declared a usage removal. If the module removal involved a mixture of MOT part removals and usage part removals, the module is classified as multiple parts with at least one scheduled removal.

7. After completion of module removal classifications, another portion of the OMENS15S/16S program is entered to determine the engine removal disposition and code. This part of the program adds up the number of modules removed to determine if the engine is to be NRTS to depot as a whole-up engine or not. The

logic is stated as follows: if three of the four main modules, or which include the FDT, HPC, Inlet Fan, and HPT, need repair and any one of the other modules, (excluding accessories-1 and accessories-2) also needs repair, the engine is NRTS to depot. This is called the Rule of 4 Policy. Since this logic is not firm, the program enables the user to test for different values other than 4 and so the policy is often referred to as the Rule of X where X is limited to the maximum number of modules involved in the engine, but three of the four main modules named must always be included.

8. The next portion of the program tallies all of the removals for parts, modules, and complete engine and records the disposition of each. This enables the output talbes to be processed showing engine removals, what modules drove the removals and what parts drove the modules. Repair dispositons are also determined here, i.e. whether the modules are repaired at base or depot. Base screens are applied to see if individual parts within the module qualify for screening removal and subsequent replacement. If the engine is to be NRTS, depot screens are applied at the depot level for screening parts and replacement of these parts.

9. The process described above is carried on until the entire simulation period, ISIMYRS (input by the user), is reached. Output showing the number of screened out parts by module and the disposition of the modules is made periodically throughout the run according to the report period, ISIMPRD, defined at input time. Other more detailed output is described later in this Working Paper.

Chapter IV

Input

1. The OMENS III program consists of 3 other files needed for a simulation run. The main files contain the program logic and the internal data. These files are named LAU/OMENS15S and LAU/OMENS16S and are the source program files. The internal data in these programs contain all the names and indices of the engine and its modules and all the various life-limited parts. This data also has all the actuarial, pipeline, and cost factors associated with each component. These values such as NRTS rates, removal rates, cycle, TOT or engine flying hour limits, and costs are those given in the Design Maintenance Concept or in various other official projections approved by HQ AFLC/LOP, Wright-Patterson AFB, Ohio 45433. The values will be discussed in detail in Chapter VI. The program logic and two different sets of the internal data combine to form the two source programs, OMENS15S and OMENS16S as previously stated. These files are then compiled into object decks named OMENS15O and OMENS16O respectively. These object files are binary object decks of source programs. Both programs are already compiled so they do not have to recompile every time a simulation run is needed.

2. The file that is most important to the actual run has read permission and is called LAU/OMENSRUN, R. An example run

is shown at the end of this chapter in Figure 1, to aid in the explanation of the variable input required. Each entry is discussed below in the appropriate input order as it appears in the interactive input section of OMENSRUN, R.

a. F-15/F-16 Model. This first question is self-explanatory. Choose whichever model is necessary for evaluation of either F-15 or F-16 aircraft with the appropriate entry.

b. M Rule. The next entry should be the X value for the policy Rule of X. This Rule of X states how many modules must be in need of repair before they are sent to the depot together as an engine NRTS. The engine is considered a Policy Rule NRTS if three of the following four modules: HPC, HPT, FDT, and Inlet Fan, are in need of repair and the total number of modules needing repair equals or exceeds the value of X. (Accessories-1 and Accessories-2 do not count as modules in the Policy Rule.)

c. ISMAX. This is the third required entry. It is the total number of runs desired, and it can take on any value from 1 through 9. This value determines how many simulation runs will be made under one program run (using the same interactive input for the data).

d. IP. This required entry is the print indicator and dictates either a long or short form of printout from the simulation run. If a complete long printout is desired a 0 should be used. If a summary or short form printout is desired, a 1 should be used.

e. KS. This next entry indicates if a standard or random seed is desired. If a standard seed is desired a 0 should be used. It should be noted here that if a standard seed is used there is no point in generating more than one identical seed run and thus the ISMAX entry (discussed in number 3 above as how many runs are desired) should be a 1. If a random seed is desired, a 1 should be used.

f. KW. This entry dictates whether or not warmup is desired. If it is desired to have all the parts start out the simulation with 0 accumulated age (new parts) a 0 should be entered. If warmup is desired (a random mixture of parts ages to start the simulation) a 1 should be input.

g. LFCYC. This two-position entry is the life cycle value in years used to compute the objective function, i.e., the cost function over a particular life cycle period.

h. SIMYRS. This entry is the number of simulation years desired for the program run. The entry must be three positions.

i. MONUTR. This data line entry stands for the monthly utilization rate desired on the engine in flying hours. The entry must be two positions.

j. JTOL. This entry calls for a three-position tolerance value. The tolerance value is an arbitrarily assigned value to simulate the removal of parts that are so close to failure that signs of wear dictate their premature removals

before they actually fail or reach MOT. The models are usually run with an arbitrary tolerance value of 010. In engine flying hours, this assumes all parts within 10 hours of their failure time will be removed for tolerance when the module is already in for repair.

k. FACT. This entry calls for an overfly value. This is an option put into the program to allow for peace or wartime maximum operating time fluctuations. For example, if the user wished to increase the MOTs on all the parts by a factor of 10 percent, 1.1 would be the correct entry for that factor. If the MOTs are not to be altered, a 1.0 would be entered.

1. ISCRN (J,K). This section of the interactive input requests a base screen and a depot screen for every part in every module, including all dummy parts in the engine. First, the base screen is entered below the name of the part, then a comma delimiter and then the depot screen desired. Constant values from 0 through 9999 are acceptable as input.

3. After the user is finished with this portion of the interactive input, the program is designed to print out a replication of the data entered. Immediately following this, the computer-generated job control number prints out. Then the user has one more option question to answer. If other run parameters are desired to be tested, a 1 should be typed and if no other runs are wanted, a 0 (zero) should be typed in to terminate the program.

4. An alternative to running this program is to call LAU/-OMENS.15 (for F-15) and LAU/OMENS.16 (for F-16) and edit as appropriate. To edit, the user should run at least one run with LAU/OMENSRUN so that the spacing and proper entries will be made and revised correctly. The screens are read across, first the base, then the depot in the same part order as seen in LAU/OMENSRUN. See example below to match up requested run variables entered in LAU/OMENSRUN with desired changes to OMENS.15 or OMENS.16 as appropriate.

```
SYSTEM ?CARD 0 OMENS.15
READY
*LIST

0010##NORM
0020$:IDENT:WP1326,XRS/JINYA    OMENS.15
0030$:OPTION:FORTRAN,NOMAP
0040$:SELECT:LAU/OMENS150
0050$:EXECUTE
0060$:LIMITS:3,20K,,5K
0070$:DATA:I*
80#4 2 0 1 1 20 200 17 010 1.0
090#     0    0  200 2000  120 2000  300 2000  320 2000  360 2000  145 2000
100#   145 2000  200 2000  340 2000  330 2000  300 2000 1000 2000 1000 2000
110#  1000 2000 1000 2000 1000 2000  100 2000  470 2000  875 2000  410 2000
120#   550 2000  280 2000  280 2000  280 2000  280 2000  280 2000  750 2000
130#   750 2000  650 2000 1050 2000  275 2000  375 2000  415 2000  775 2000
140#   700 2000  575 2000  675 2000  775 2000  300 2000 1215 2000 1470 2000
150#   270 2000  270 2000  270 2000  250 2500  330 2500  300 2500 1000 2500
155#     0    0    0    0    0    0    0    0    0    0    0    0    0    0
160$:ENDJOB

ready
```

FIGURE 1

```
SYSTEM ?YFORT Q OMENSRUN
READY
*RUN
<W>7 MEMORY EXPANDED. USE $LIMITS OR CORE= OPTION FOR NEXT RUN

FOR A COMPLETE EXPLANATION OF OMENSRUN ENTER 1, OTHERWISE Ø
=Ø
*DONE
SYSTEM ?YFORT Q OMENSRUN
READY
*RUN
<W>7 MEMORY EXPANDED. USE $LIMITS OR CORE= OPTION FOR NEXT RUN

FOR A COMPLETE EXPLANATION OF OMENSRUN ENTER 1, OTHERWISE Ø
=Ø
ENTER 1 FOR F15 MODEL;
ENTER 2 FOR F16 MODEL.
=1
ENTER RULE OF X.
=4
ENTER THE NUMBER OF RUNS DESIRED.
=2
ENTER Ø FOR FULL PRINTOUT, 1 FOR SHORT FORM PRINTOUT
=Ø
ENTER Ø FOR STANDARD SEED, 1 FOR RANDOM SEED
=1
ENTER Ø FOR NEW PARTS (NO WARMUP) OR 1 FOR WARMUP
=1
ENTER TWO-POSITION LIFE CYCLE VALUE
=2Ø
ENTER THREE-POSITION SIMULATION PERIOD VALUE
=2ØØ
ENTER TWO-POSITION MONTHLY UTILIZATION RATE VALUE
=17
ENTER THREE-POSITION TOLERANCE VALUE
=Ø1Ø
ENTER OVERFLY VALUE. NO OVERFLY, ENTER 1.Ø
=1.Ø
ENTER BASE SCREEN, DEPOT SCREEN AND HIT CARRIAGE RETURN
FOR EACH PART NUMBER IN MODULE  1 CONTAINING PART NUMBERS
 1 THROUGH   1
7ØØ AUGM DUMMY
=Ø.Ø
```

FIGURE 1 (cont.)

```
ENTER BASE SCREEN, DEPOT SCREEN AND HIT CARRIAGE RETURN
FOR EACH PART NUMBER IN MODULE  2 CONTAINING PART NUMBERS
 2 THROUGH  8
104 UFC
=200,2000
AFPC/FOC
=120,2000
AOC
=300,302000
AFP
=320,2000
RCVV/IAIV
=360,2000
301 VANE
=145,2000
302 VANE
=145,2000
ENTER BASE SCREEN, DEPOT SCREEN AND HIT CARRIAGE RETURN
FOR EACH PART NUMBER IN MODULE  3 CONTAINING PART NUMBERS
 9 THROUGH 17
300 FAN DUMMY
=200,2000
303 1STG DISK
=340,2000
304 2STG DISK
=330,2000
305 3STG DISK
=300,2000
306 1STG SEAL
=1000,2000
307 FRNT SEAL
=1000,2000
308 REAR SEAL
=1000,2000
309 RETAINER
=1000,2000
310 2STG SEAL
=1000,2000
```

FIGURE 1 (cont.)

```
ENTER BASE SCREEN, DEPOT SCREEN AND HIT CARRIAGE RETURN
FOR EACH PART NUMBER IN MODULE 4 CONTAINING PART NUMBERS
18 THROUGH 39
400 CORE DUMMY
=100,2000
401 4STG SEAL
=470,2000
402 5STG SEAL
=875,2000
403 6STG SEAL
=410,2000
404 7STG SEAL
=550,2000
405 8STG SEAL
=280,2000
406 9STG SEAL
=280,2000
407 10STG SEAL
=280,2000
408 11STG SEAL
=280,2000
409 12STG SEAL
=280,2000
410 13STG SEAL
=750,2000
411 4STG DISK
=750,2000
412 5STG DISK
=650,2000
413 6STG DISK
=1050,2000
414 7STG DISK
=275,2000
415 8STG DISK
=375,2000
416 9STG DISK
=415,2000
417 10STG DISK
=775,2000
418 11STG DISK
=700,2000
419 12STG DISK
=575,2000
420 13STG DISK
=675,2000
421 REAR SHAFT
=775,2000
```

FIGURE 1 (cont.)

```
ENTER BASE SCREEN, DEPOT SCREEN AND HIT CARRIAGE RETURN
FOR EACH PART NUMBER IN MODULE  5 CONTAINING PART NUMBERS
40 THROUGH 45
500 HPT DUMMY
=300,2000
501 1STG DISK
=1215,2000
502 2STG DISK
=1470,2000
503 2STG DISK
=270,2000
504 1STG FPLT
=270,2000
505 1STG RPLT
=270,2000
ENTER BASE SCREEN, DEPOT SCREEN AND HIT CARRIAGE RETURN
FOR EACH PART NUMBER IN MODULE  6 CONTAINING PART NUMBERS
46 THROUGH 49
600 FDT DUMMY
=250,2500
601 3STG DISK
=330,2500
602 4STG DISK
=300,2500
603 4STG DISK
=1000,2500
ENTER BASE SCREEN, DEPOT SCREEN AND HIT CARRIAGE RETURN
FOR EACH PART NUMBER IN MODULE  7 CONTAINING PART NUMBERS
50 THROUGH 50
800 GBOX DUMMY
=0,0
ENTER BASE SCREEN, DEPOT SCREEN AND HIT CARRIAGE RETURN
FOR EACH PART NUMBER IN MODULE  8 CONTAINING PART NUMBERS
51 THROUGH 51
900 ACCS DUMMY
=0,0
.......,ROUT AC
$:IDENT:WP1326,XRS/JINYA    OMENSRUN
$:OPTION:FORTRAN,NOMAP
$:SELECT:LAU/OMENS150
$:EXECUTE
$:LIMITS:3,20K,,5K
$:DATA:I*
#4  2 0 1 1 20 200 17  10 1.0
#     0    0  200 2000   120 2000   300 2000   320 2000   360 2000   145 2000
#   145 2000  200 2000   340 2000   330 2000   300 2000  1000 2000  1000 2000
#  1000 2000 1000 2000  1000 2000   100 2000   470 2000   875 2000   410 2000
#   550 2000  280 2000   280 2000   280 2000   280 2000   280 2000   750 2000
#   750 2000  650 2000  1050 2000   275 2000   375 2000   415 2000   775 2000
#   700 2000  575 2000   675 2000   775 2000   300 2000  1215 2000  1470 2000
#   270 2000  270 2000   270 2000   250 2500   330 2500   300 2500  1000 2500
#     0    0    0    0     0    0     0    0     0    0     0    0     0    0
$:ENDJOB
  SNUMB # 0294t
ENTER 1 TO TEST OTHER RUN PARAMETERS:
ENTER 0 TO TERMINATE PROGRAM.
=0
```

Chapter V

Output

1. The complete output from a run of program LAU/OMENSRUN,R is in several sections as follows:

   a. Actuarial Input Factors.

   b. Engine Removals Report Period Summary.

   c. Engine NRTS Analysis.

   d. Module Removals Report Period Summaries.

   e. Module Removals Summary.

   f. Parts Removal Summaries.

   g. Objective Function - Engine.

   h. Objective Function - Modules.

   i. Life-Limited Parts Replacements Costs.

   j. Objective Function Summary.

   k. Screen, NRTS rate and Removals Per 1000FH Summary.

   l. Averages Summary.

2. Sections (a) through (k) inclusive will be printed as output if the long printout is requested. If the short form printout is requested, sections a, b, c, e, j, and k are printed as output. Individual output sections are discussed in the following paragraphs.

3. <u>Actuarial Input Factors</u>. This output section displays all the actuarial input data necessary for a program run. The engine factors appear first, showing the depot and base pipeline factors, stock list price and depot and base maintenance

cost factors. The depot cost factor is the average repair cost of an engine at depot and the base cost factor is the average maintenance cost at base level. (As a rule, extensive engine maintenance is not carried out at base level, thus the cost is quite low.) Next, the module factors appear with input variable comparable to those of the engine. In addition, each module has a section displaying input factors for the parts. All the tables are the same configuration and described below.

a. Part No. Number assigned to the part in the module and used as cross-reference to the part in the program.

b. Part Name. The part name as it will appear and be referenced throughout the program.

c. Convert Ratio. This is the factor used to convert cycles or total operating hours into engine flying hours so that the program can clock in the same units.

d. Max Time. This is the input maximum operating time assigned to the parts in the G337 Report.

e. Base Screen. This is the screen chosen by the program user to apply against the life remaining on the part in questino at the base level.

f. Depot Screen. This is the screen chosen by the program user to apply against the life remaining on the part in question at the depot level.

g. Scale Parameter. This is the value needed to generate failures according to a Weibull distribution. It is computed internally in the program from the initial removals per 1000 flying hours factor for the dummy parts. The other parts in each module are set arbitrarily large since they do not generate unscheduled removals, only maximum operating time and screened removals.

h. Unit Price. This is the average stock list price for replacing the part.

DATA22OCT79 ACTUARIAL INPUT FACTORS PAGE 1

ENGINE F100PW100(F15)

DATE 110179 TIME 12.14 SEC 11

DEPOT PIPE IS 56 BASE PIPE IS 4 LIST PRICE IS 1700000
DEPOT MAINT COST IS 14652 BASE MAINT COST IS 161

700 AUGMENTOR

DEPOT PIPE IS 41 BASE PIPE IS 4 LIST PRICE IS 360000
DEPOT MAINT COST IS 2899 BASE MAINT COST IS 775
TRANSPORT COST 2066 MANHOUR DATA 30
INITIAL REM/1000FH 1.5067 DUMMY SHAPE IS 1.000

PART NO.	PART NAME	CONVERT RATIO	MAX. TIME	BASE SCREEN	DEPOT SCREEN	SCALE PARAM	UNIT PRICE
1	700 AUGM DUMMY	1.000	00000.	0	0	563	0

100 ACC1 WLL

DEPOT PIPE IS 4 BASE PIPE IS 2 LIST PRICE IS 0
DEPOT MAINT COST IS 846 BASE MAINT COST IS 846
TRANSPORT COST MANHOUR DATA 23
INITIAL REM/1000FH 0. DUMMY SHAPE IS 5.000

PART NO.	PART NAME	CONVERT RATIO	MAX. TIME	BASE SCREEN	DEPOT SCREEN	SCALE PARAM	UNIT PRICE
2	104 UFC	1.600	2000.	200	2000	990000	1000
3	AFPC/FOC	1.600	1200.	120	2000	990000	1000
4	AOC	1.600	3000.	300	2000	990000	1000
5	AFP	1.600	3200.	320	2000	990000	1000
6	RCVV/IAIV	1.600	3600.	360	2000	990000	1000
7	301 VANE	1.600	1454.	145	2000	990000	3890
8	302 VANE	1.600	1454.	145	2000	990000	828

300 FAN

DEPOT PIPE IS 36 BASE PIPE IS 4 LIST PRICE IS 177000
DEPOT MAINT COST IS 2667 BASE MAINT COST IS 839
TRANSPORT COST 888 MANHOUR DATA 78
INITIAL REM/1000FH 0.3050 DUMMY SHAPE IS 1.000

PART NO.	PART NAME	CONVERT RATIO	MAX. TIME	BASE SCREEN	DEPOT SCREEN	SCALE PARAM	UNIT PRICE
9	300 FAN DUMMY	2.200	2000.	200	2000	3278	0
10	303 1STG DISK	2.200	3400.	340	2000	990000	7310
11	304 2STG DISK	2.200	3300.	330	2000	990000	6054
12	305 3STG DISK	2.200	3000.	300	2000	990000	5016
13	306 1STG SEAL	2.200	10000.	1000	2000	990000	1848
14	307 FRNT SEAL	2.200	10000.	1000	2000	990000	1106
15	308 REAR SEAL	2.200	10000.	1000	2000	990000	1347
16	309 RETAINER	2.200	10000.	1000	2000	990000	744
17	310 2STG SEAL	2.200	1000 .	1000	2000	990000	2045

400 CORE

DEPOT PIPE IS 48 BASE PIPE IS 8 LIST PRICE IS 704000
DEPOT MAINT COST IS 5422 BASE MAINT COST IS 2500
TRANSPORT COST 2013 MANHOUR DATA 850
INITIAL REM/1000FH 0.6100 DUMMY SHAPE IS 1.000

PART NO.	PART NAME	CONVERT RATIO	MAX. TIME	BASE SCREEN	DEPOT SCREEN	SCALE PARAM	UNIT PRICE
18	400 CORE DUMMY	2.200	2000.	100	2000	1639	0
19	401 4STG SEAL	2.200	9400.	470	2000	990000	1093
20	402 5STG SEAL	2.200	17500.	875	2000	990000	1280
21	403 6STG SEAL	2.200	8200.	410	2000	990000	1424
22	404 7STG SEAL	2.200	11000.	550	2000	990000	1163
23	405 8STG SEAL	2.200	5600.	280	2000	990000	1742
24	406 9STG SEAL	2.200	5600.	280	2000	990000	1118
25	407 10STG SEAL	2.200	5600.	280	2000	990000	3292
26	408 11STG SEAL	2.200	5600.	280	2000	990000	3308
27	409 12STG SEAL	2.200	5600.	280	2000	990000	3369
28	410 13STG SEAL	2.200	15000.	750	2000	990000	5283
29	411 4STG DISK	2.200	15000.	750	2000	990000	4708
30	412 5STG DISK	2.200	13000.	650	2000	990000	3893
31	413 6STG DISK	2.200	21000.	1050	2000	990000	8134
32	414 7STG DISK	2.200	5500.	275	2000	990000	6764
33	415 8STG DISK	2.200	7500.	375	2000	990000	4448
34	416 9STG DISK	2.200	8300.	415	2000	990000	8549
35	417 10STG DISK	2.200	15500.	775	2000	990000	4441
36	418 11STG DISK	2.200	14000.	700	2000	990000	8448
37	419 12STG DISK	2.200	1050 .	575	2000	990000	4641
38	420 13STG DISK	2.200	13500.	675	2000	990000	6486
39	421 REAR SHAFT	2.200	15500.	775	2000	990000	9793

500 H P TURB

DEPOT PIPE IS 24 BASE PIPE IS 5 LIST PRICE IS 131028
DEPOT MAINT COST IS 1201 BASE MAINT COST IS 850
TRANSPORT COST 423 MANHOUR DATA 958
INITIAL REM/1000FH 0.9150 DUMMY SHAPE IS 1.000

PART NO.	PART NAME	CONVERT RATIO	MAX. TIME	BASE SCREEN	DEPOT SCREEN	SCALE PARAM	UNIT PRICE
40	500 HPT DUMMY	2.200	200 .	300	2000	1092	0
41	501 1STG DISK	2.200	8100.	1215	2000	990000	14553
42	502 2STG DISK	2.200	9800.	1470	2000	990000	12416
43	503 2STG DISK	2.200	1800.	270	2000	990000	6023
44	504 1STG FPLT	2.200	1800.	270	2000	990000	2344
45	505 1STG RPLT	2.200	1800.	270	2000	990000	958

600 FAN DR TUR

DEPOT PIPE IS 29 BASE PIPE IS 5 LIST PRICE IS 169000
DEPOT MAINT COST IS 1959 BASE MAINT COST IS 536
TRANSPORT COST 1107 MANHOUR DATA 113
INITIAL REM/1000FH 0.3965 DUMMY SHAPE IS 1.000

PART NO.	PART NAME	CONVERT RATIO	MAX. TIME	BASE SCREEN	DEPOT SCREEN	SCALE PARAM	UNIT PRICE
46	600 FDT DUMMY	2.200	2500.	250	2500	2522	0
47	601 3STG DISK	2.200	3300.	330	2500	990000	8024
48	602 4STG DISK	2.200	3000.	300	2500	990000	6502
49	603 4STG DISK	2.200	10000.	1000	2500	990000	15017

800 GEARBOX

DEPOT PIPE IS 25 BASE PIPE IS 2 LIST PRICE IS 23000
DEPOT MAINT COST IS 755 BASE MAINT COST IS 180
TRANSPORT COST 200 MANHOUR DATA 18
INITIAL REM/1000FH 0.2989 DUMMY SHAPE IS 1.000

PART NO.	PART NAME	CONVERT RATIO	MAX. TIME	BASE SCREEN	DEPOT SCREEN	SCALE PARAM	UNIT PRICE
50	800 GBOX DUMMY	1.600	4000.	0	0	3345	0

900 ACC2 WOLL

DEPOT PIPE IS 0 BASE PIPE IS 1 LIST PRICE IS 0
DEPOT MAINT COST IS 124 BASE MAINT COST IS 0
TRANSPORT COST MANHOUR DATA 16
INITIAL REM/1000FH 1.7179 DUMMY SHAPE IS 1.000

PART NO.	PART NAME	CONVERT RATIO	MAX. TIME	BASE SCREEN	DEPOT SCREEN	SCALE PARAM	UNIT PRICE
51	900 ACCS DUMMY	1.000	00000.	0	0	582	0

4. Engine Removals Report Period Summary. This table shows which seed run is being reported, the simulation period and report period chosen, the life cycle period and monthly utilization rate desired, whether or not warmup and random seeds were used for the run, the number of modules involved and the Rule of X value. It also displays an inut engine NRTS rate and removals per 1000 FH and computed outputs for these two terms. The chart immediately following this shows by report how many and which modules failed or reached MOT causing an engine removal. See Table 2.

a. Report Period K. This K value tallies how many report periods were desired in the simulation run.

b. Report Period Hours. This value is the amount of engine flying hours that have been reached since the first K report period started. It is cumulative so that its last value equates to the value chosen for the entire simulation run.

c. One Module Fails Early. This column tallies how many times an engine was removed due to a single module failure.

d. Many Modules (Fail) Early. This column tallies how many times an engine was removed due to multiple module failures.

e. Many Modules U + T. This column records how many times an engine was removed due to a combination of usage and time (MOT) module removals for failures and scheduled checks respectively.

f. One MOT Reached. This column records how many times an engine was removed due to a single scheduled module removal.

g. Total. This column now adds the other columns up row-wise for a total by report period.

h. Totals. This line appears at the bottom of the table and adds each column for a total of the different removal reasons listed and a grant total on the far right under the Total column described in (g) above.

5. Engine NRTS Analysis. These tables appear on page three of the printout. Table 3 displays a distribution of module removals that were NRTS to the depot as single modules and Table 4 shows those that were NRTS as part of the engine Rule of X Policy. See Table 3.

a. Item. This column displays which module (by item number) is involved.

b. Base RTS. This column shows which modules did not get sent to the depot as lone modules but were classified as base repairs.

c. Initial NRTS Percent. This column displays input NRTS % rates as established by management.

d. Usage NRTS. This column gives the total number of times during the simulation run that each module was removed and NRTS as a lone module for usage purposes. It is computed by comparing a random number to the initial NRTS percent for each module. If the random number is less than or equal to the NRTS % the module is considered to be NRTS. If the random number is greater than the NRTS %, the module is considered to be Base RTS.

e. U-Screen NRTS. This column shows the total number of times during one complete simulation run that each module was removed for usage and at the same time found to be within its screening interval and thus NRTS as a lone module.

f. Scheduled NRTS. This column gives the total number of times during one complete simulation run that each module was removed and NRTS as a lone module for scheduled purposes, i.e., reaching its life limit.

g. Screen NRTS. This is the seventh column in the table and it records the total number of times each module was removed and NRTS alone for screening reasons.

h. Total NRTS. This column adds up all the NRTS alone categories for each module and shows the total of the NRTS alone removals by module.

i. Final NRTS Percent Alone. This column lists the final NRTS percent for each module (those not part of the engine Rule of X Policy). It takes the total NRTS alone removals and divides that number by the base RTS plus the total NRTS removals for each module.

j. Removals Per 1000 FH. This is the last column of the first table. It records the final removal rate for lone modules by adding the RTS plus total NRTS alone and dividing this total by the simulation period and multiplying by 1000 to get removals per 1000 FH.

6. Engine NRTS Analysis, NRTS with Engine NRTS Policy. This table shows similar information as in Table 3, except all modules were part of the engine NRTS due to the Rule of X Policy, where X was determined at the beginning of the simulation run. See Table 4.

a. Item. Number assigned to the module involved. Statistics are read by row.

b. Usage NRTS. This column records all the usage removals of modules that went to the depot as part of the engine due to the Rule of X Policy or the initial engine usage NRTS applied.

c. U-Screen NRTS. This column records by module which removals were for usage and at the same time were found to be eligible to be screened out. These modules would therefore be NRTS. However, they are part of the engine Rule of X

Policy so they become classed as an engine NRTS and are not counted as module NRTS.

d. Scheduled NRTS. This column gives the total number of times during the simulation run that each module had reached its MOT, but was sent to the depot as part of the Rule of X Policy and removed there.

e. Screen NRTS. This is the fifth column shown in this table. It records the total number of screened modules that were sent to the depot as part of the complete engine for removal and repair at the depot level.

f. Total NRTS. This adds the total number of module removals for cause that occurred at depot as a result of going with the complete engine because of the Rule of X Policy.

g. Not Effected But NRTS. This last column records how many times good modules were sent to the depot as part of a whole engine due to the Rule of X Policy. These modules were not effected by malfunctioning, reaching MOT, or screening and otherwise would not have been removed or repaired as a separate module. These modules are simply "going along for the ride" as part of an engine NRTS.

h. Total. This line simply adds up how many total modules were sent to the depot as engine NRTS for the various removal reasons explained above.

i. Total Engine NRTS. This line shows how many times the engine was considered NRTS due to the Rule of X Policy.

j. Engine NRTS Percent. This is the percent of engine removals that were NRTS to the depot as part of the Policy.

k. Total Removals Per 1000 FH. This line calculates the total number of engine removals per 1000 FH by taking the total number of removals and dividing

by the total number of flying hours in the simulation run and multiplying the result by 1000.

l. Engine Usage NRTS. This is the total amount of times an engine was sent to depot as an unscheduled engine NRTS by applying the initial engine NRTS rate.

m. Rule of X NRTS. This is the total amount of Policy engine removals sent to the depot.

7. Module Removals Report Period Summary. The next set of tables shows module removal summaries on a separate table for each module. Each table is alike so the following description appears only once and applies to all Module Removals Report Period Summary Tables. The core is used as an example on Table 5. The heading entries are self-explanatory.

a. Report Period K. This K value identifies each period by number.

b. Report Period Hours. This value is the amount of engine flying hours that have been reached since the first K report period started. It is cumulative so that its last value equates to the value chosen for the entire simulation run.

c. One Part Fails Early. This column tallies how many times the module was removed due to a single part failure.

d. Many Parts (Fail) Early. This column tallies how many times the module was removed due to multiple part failures.

e. Many Parts U + T. This column records how many times the module was removed due to a combination of usage and time (MOT) part removals for failures and scheduled checks respectively.

f. One MOT Reached. This column records how many times the module was removed due to a single scheduled part removal.

g. Parts Screened Out. This column records how many times a part was screened out of the module opportunistically during the report period K.

h. Total. This column adds the other colmns up row-wise for a total by report period of parts removals.

i. Totals. This line appears at the bottom of the table and adds each column for a total of the different parts removed as listed and a grant total on the far right under the Total column described in (h) above.

j. Removals Per 1000 EFH. This line is followed by input base removals and computed output base, depot and total removals per 1000 EFH.

k. NRTS Percent. This line is followed by input base level NRTS and computed base level, depot level and total NRTS percent.

l. Percent Depot Repair. This line compares the total number of depot removals with the total number of removals for cause and yields percentages respectively.

8. Module Removals Summary. This tables shows the removal reasons for each module and how many times each was removed due to the parts needing replacement. See Table 6.

a. M. Number assigned to module involved.

b. Module Nomenclature. Name assigned to module involved. These names are used throughout the printout.

c. Use. This column shows how many times each module was removed due to a failure of one of its parts.

d. U-Dep. This column records usage removals that also qualified to be screened and shows which modules had parts removed and how many were removed.

e. Time. This column tallies which modules were removed due to scheduled parts replacements and how many were removed.

f. Screen. This column records screened parts removals, showing how many were screened and from which modules.

g. Total. This column totals parts removals by module.

h. Grand Total. This row totals the individual columns and gives a grant total at the far right.

9. Parts Removal Sumamry. This set of tables shows parts removal summaries, one table per individual module. Each table shows all the life-limited parts in the module as well as the "dummy" part. The dummy part accounts for all the premature removals experienced by the module. All the reasons for removals are shown for each part. The value of the screen interval, whether originally input as a percent of MOT or a constant is also shown. The core module is used as example in Table 7.

a. Part No. J. Number assigned to part involved.

b. Part Name. Self-explanatory.

c. Usage Removals. This column records all the parts removed for usage purposes on the module.

d. Tolerance Removals. This column records removals of parts that were so close to failure that signs of wear dictated their premature removals (before they actually failed or reached MOT).

e. U-Dep Removals. This column records parts usage removals that also qualified to be screened.

f. Time Removals. This column records all parts removed due to reaching their life limits.

g. Screen Removals. This column records screened out parts in the module.

h. Total. This column totals parts removals by module.

i. Base Screen. This column shows the constant screen applied to each part.

j. Module Totals. This row totals up the number of each type of module removal that ensued due to a part needing repair or replacement.

10. Objective Function - Complete Engine Maintenance Costs. The objective function relates input cost data to computer generated engine removals data to assign maintenance and pipeline costs to be chosen life-cycle period. See Table 8.

.a. Engine Removals. This value is previously computed based on the Rule of X chosen, the engine usage NRTS applied, and the total amount of engines reparable this station (RTS).

b. *"LFCYC"/"SIMYRS". These values are inputted by the user before the run. The desired life cycle divided by the total number of simulation years becomes the factor needed to scale down the total NRTS removals to a life cycle's worth.

c. Rem/Replace Cost/Removal. This is the average maintenance cost per engine removal at base level attributable to the engine itself, excluding additional module costs.

d. Average Base Cost Per Removal. This figure is computed by a complicated section of program logic which counts in which modules were removed and how much dollars were spent each time to remove and replace them. It is cumulated and divided by the total number of base engine removals to obtain this average.

e. Depot Cost/Engine. This input value is the average depot repair cost experienced by San Antonio ALC.

f. Total "Life Cycle" Years Depot and Base. This column is computed by multiplying 15 years worth of NRTS removals times the average depot repair cost and adding this to the 15 years worth of base removals times the average base cost per engine.

11. Objective Function - Module Maintenance Cost With. See Table 8, bottom.

a. Item. This column displays which module (by item number) is involved.

b. Module Nomenclature. This column denotes the name and number assigned to the different modules in the program simulation.

c. Total NRTS Module Removals. This number is the total NRTS modules that were NRTS as part of the engine Rule of X Policy.

d. *"LFCYC"/"SIMYRS". These values are inputted by the user before the run. In general, the value computes a life cycle from a particular simulation period. Both the life cycle length and the total simulation period are chosen by the user before the run is made.

e. Depot Cost Factor. This value is input data internal to the program. It is the average repair cost for each item (module) at the depot level.

f. Total "Life Cycle" Years Depot. This value is computed for each module by multiplying the life cycle value of NRTS removals for each module times the depot cost factor, yielding a total life cycle's worth of costs by module for depot repair.

g. Total. This value cumulates the total life cycle cost at te depot for each module and yields a total additional cost to the depot engine repair cost for the same life cycle period.

12. Objective Function - Complete Engine Pipeline Costs. See Table 9.

a. Daily Demand Rate.

(1) Removal/1000 FH. This value is the final removals per 1000 flying hours for the engine computed in the simulation run. It is used here to determine the daily demand rate in conjunction with the conversion factor below.

(2) *"MONUTR"/30000. This value is multiplied times the removals per thousand hours to compute a daily demand rate. Monutr is a term meaning monthly

utilization rate and is input by the user at the beginning of the run. Thus, the removals/1000 FH multiplied by, say 17 flying hours per month is:

$$\frac{\text{REMOVALS}}{\text{1000 FH}} * \frac{17}{30} = \text{DAILY DEMAND RATE}$$

b. NRTS Rate. This is the percentage value of engine removals that were NRTS to depot divided by the total number of engine removals.

c. NRTS Pipe. This column lists the input standard depot pipeline repair days for the engine.

d. Base Rate. This is the percentage value of engine removals that were repaired at base divided by the total number of engine removals.

e. Base Pipe. This value is input data internal to the program and shows the standard base pipeline repair days for the engine.

f. Pipeline Quantity. This value is computed by taking the daily deamdn rate and multiplying it by the percentage of NRTS engines times its standard depot pipeline repair time plus the percentage of base repaired engines times its standard base pipeline repair time. The equation is:

$$\begin{array}{c} \text{PIPELINE} \\ \text{QUANTITY} \end{array} = \begin{array}{c} \text{DAILY DEMAND} \\ \text{RATE} \end{array} \quad \begin{array}{c} \text{NRTS} \\ \frac{\text{RATE}}{100} \end{array} \quad \begin{array}{c} \text{*NRTS} \\ \text{PIPE} \end{array} + \begin{array}{c} \text{BASE} \\ \frac{\text{RATE}}{100} \end{array} \quad \begin{array}{c} \text{*BASE} \\ \text{PIPE} \end{array}$$

g. Stock List Price. This value is inputted and is the approximate procurement cost in today's dollars of an F100PW100 engine.

h. Total Cost. This is a computed value found by multiplying the pipeline quantity times the stock list price.

13. Objective Function - Module Maintenance Costs Alone. See Table 10.

a. Item. As previously noted.

b. Total NRTS Module Removals. This column records the total amount of module removals (by module) that needed depot level repair and were sent as a separate unit rather than with the whole engine.

c. *"LFCYC"/"SIMYRS". These values are user inputted at the beginning of the run. It is used to scale down total removals for the entire simulation period to a life cycle's worth of removals. This is done by multiplying the total removals by the factor consisting of the life cycle divided by the total number of years in the simulation.

d. Depot Cost Factor. This column lists input data that was computed by averaging the amount of manhours spent to repair each module at the depot. Then a cost per manhour factor was applied to obtain the average depot cost per module. Then this factor is carried in the input data.

e. Total Base Module Removals. This column records the total amount of times each module was removed and repaired or replaced at base level.

f. *"LFCYC"/"SIMYRS". See Item 13(c) above.

g. Base Cost Factor. This column shows input data that was computed by averaging the amount of manhours spent to repair each module at the base. Then a cost per manhour factor was applied to obtain the average base cost per module and this factor is carried in the input data.

h. Total "LFCYC" Years Depot and Base. This column obtains its values by taking the life cycle's worth of depot removals times the depot cost factor and adding to this value the life cycle's worth of base removals times the respective base cost factor.

14. Module Pipeline Costs. This table shows the pipeline cost breakdown incurred by module. See Table 11.

a. Item. As explained previously.

b. Daily Demand Rate.

(1) Removals/1000 FH. These values are the final removals per 1000 flying hours computed in the simulation run for each module.

(2) *"MONUTR"/30000. This value is multiplied times the removal/1000 FH above to compute a daily demand rate. Monutr means monthly utilization rate and is user inputted at the beginning of the run. It is divided by 30,000 because there are approximately 30 days per month and the removal rate is given per 1000 FH, hence 30 * 1000 = 30000.

c. NRTS Pipe. This column lists the standard depot pipeline repair days for each module.

d. Base Pipeline. This column lists the standard base pipeline repair days for each module.

e. Pipeline Quantity Per Module. This column finds the fraction of depot removals times the depot pipe and adds to it the fraction of base removals times the base pipe and then multiples this sum by the daily demand rate for each module.

f. Module Price. This value is inputted and is the approximate procurement cost in today's dollars of each module.

g. Cost Per Module. This value is computed for each module by multiplying the respective pipeline quantity times the module price.

15. Transportatin Costs. This table shows the transportation costs incurred by modules when sent alone and by entire engines when sent to the depot for repair. See Table 11(a).

a. Item. Self-explanatory.

b. Nomenclature. Self-explanatory.

c. NRTS Removals. This column records the total amount of module removals by module and by engine that needed depot level repair and were sent as a separate unit or as an entire engine with separate transportation costs applied.

d. *"LFCYC"/"SIMYRS". These values are user inputted at the beginning of the run. It is used to scale down total removals for the entire simulatin period to a life cycle's worth of removals. This is done by multiplying the total removals by the factor consisting of the life cycle divided by the total number of years in the simulation.

e. Transportation Cost/Removal. This value is data internal to the program. It was found by taking a weighted average of removals occurring at various bases -- the cost of sending the item to the depot from each location is known -- and computing an average transportation cost for the engine and each module.

f. "LYCYC" Year Costs. This figure is found by multiplying the average transportation cost per removal by the 15-year average NRTS removals found in the fourth column.

16. Life-Limited Parts Replacement Costs for a Particular Life Cycle. These tables are alike and show parts replacement costs for a user-inputted life cycle by module. Since the chart is repeated for each module, Table 12 shows an example chart for the core module.

a. Part Number. The number assigned to the life-limited and "dummy" parts identified in the simulation.

b. Part Name. Self-explanatory.

c. Total Scheduled Removals ("SIMYRS"). This column shows the total number of scheduled removals for the entire simulation for each part shown.

d. Scheduled Removals ("LGCYC"). This column shows the fraction of scheduled removals that took place during the desired life cycle input by the user.

e. Unit Price. This column shows the average stock list price for each part.

f. Total "LFCYC" - Year. This column multiplies the Scheduled removals in the chosen life cycle times the unit price to yield parts replacement costs for each part during the desired life cycle period.

17. Objective Function Summary. This table pulls together the maintenance costs, pipeline costs, and parts costs to yield a total cost of operating one engine for the entire life-cycle period. See Table 13.

a. Item Name. Self-explanatory.

b. Maintenance Costs.

(1) Alone. These are maintenance costs incurred by the individual modules when services alone and not as part of an engine NRTS. Base and depot costs are separated here also.

(2) With. These are maintenance costs incurred by the modules when they were part of an engine NRTS policy.

(3) Totals. This column simply adds maintenance costs alone with maintenance costs with engine NRTS policy.

c. Pipeline Costs. These values were previously computed and defined in the simulation.

d. Transportation Costs. As previously recorded.

e. Parts Costs. As previously recorded.

f. "LYCYC" - Year Costs. This column simply sums the maintenance costs, pipeline costs, and parts costs by module, and by module totals and finally row-wise for a grand total on the far right, yielding life cycle total costs.

18. Screen, NRTS Rate and Removals/1000 FH Summary. See Table 14.

a. Item Name. Self-explanatory.

b. Screen Interval. This value is the constant or percent of MOT value in engine flying hours.

c. Initial NRTS Rate %. This column is data internal to the program.

d. Initial Rem/1000 FH. This column is also data internal to the program as defined in the Design Maintenance Concept.

e. Final NRTS Rate %. This column recaps the output NRTS rate percent computed in the simulation.

f. Final Removals Per 1000 FH. This column recaps the output removals/ 1000 FH computed in the simulation run.

19. Average Data. The average data id found in Table 15. This section of the program averages the data obtained from the seed runs (if greater than one run was requested). The engine removals by report period summary, modules removals summary, objective function summary, and final NRTS rate and removals per 1000FH are all averaged as shown in the table. Each summary has been previously explained in this section.

TABLE 2

```
                         ENGINE REMOVALS                     PAGE    2
                      REPORT PERIOD SUMMARY
                         F100PW100 (F15)
DATE     110179                                        TIME 12.14 SEC 11
                                                       INPUT     OUTPUT
SEED RUN 1                                   REM/1000FH 5.7500    7.4755
SIMULATION PERIOD IS   40800                 NRTS %     7.00      7.21
REPORT PERIOD IS             4080
LIFE PERIOD FOR OBJECTIVE FUNCTION IS      20 YEARS
MONTHLY UTILIZATION RATE IS 17 FLYING HOURS
WARMUP    YES
SEED IS RANDOM
NUMBER OF MODULES  8            RULE OF X WAS   4
```

ENGINE REMOVALS

REPORT PERIOD K	HOURS	* * USAGE * * * ONE MOD. FAILS EARLY	MANY MODS. EARLY	... TIME ... MANY MODS. U+T	ONE MOT REACHED	TOTAL
1	4080	20	5	5	3	33
2	8160	20	2	9	2	33
3	12240	21	5	3	3	32
4	16320	31	3	6	1	41
5	20400	14	4	6	3	27
6	24480	10	5	4	1	20
7	28560	24	2	4	4	34
8	32640	10	6	4	3	23
9	36720	16	5	7	0	28
10	40800	16	6	4	3	29
TOTALS		182	43	52	23	300

TABLE 3

DISTRIBUTION OF MODULE REMOVALS

(NRTS RETURN TO DEPOT ALONE)

ITEM	BASE PTS	INITIAL NRTS%	USAGE NRTS	U-SCREEN NRTS	SCHED NRTS	SCREEN NRTS	TOTAL NRTS	FINAL NRTS % ALONE	REM/ 1000FH
AUG	64	9.00	6	0	0	0	6	8.57	1.7157
ACC1	0	0.		0	21	28	49	100.00	1.2010
FAN	5	56.00	6	0	7	31	44	89.80	1.2010
COR	7	76.00	17	0	12	12	41	85.42	1.1765
HPT	21	34.00	11	0	3	39	53	71.62	1.8137
FDT	14	36.00	3	0	3	25	31	68.89	1.1029
GBX	1	55.00	9	0	11	0	20	95.24	0.5147
ACC2	81	0.		0	0	0	0	0.	1.9853
TOTAL	193		52	0	57	135	244		

TABLE 4

DISTRIBUTION OF MODULE REMOVALS

NRTS WITH ENGINE NRTS POLICY

ITEM	USAGE NRTS	U-SCREEN NRTS	SCHED NRTS	SCREEN NRTS	TOTAL NRTS	NOT AFFECTED BUT NRTS
AUG	3	0	0	0	3	19
ACC1	0	0	0	22	22	0
FAN	3	0	0	19	22	0
COR	4	0	0	18	22	0
HPT	2	0	0	20	22	0
FDT	0	0	1	21	22	0
GBX	2	0	0	0	2	20
ACC2	8	0	0	0	8	14
TOTAL	22	0	1	100	123	53

TOTAL ENGINE NRTS	22
ENGINE NRTS %	7.21
TOTAL REM/1000FH	7.4755

ENGINE USAGE NRTS 21 RULE OF X NRTS 1

TABLE 5

MODULE REMOVALS PAGE 7
REPORT PERIOD SUMMARY

400 CORE

SEED RUN 1
SCREEN IS 2000; TYPE IS CONSTANT
NUMBER OF PARTS 22
MONTHLY UTILIZATION RATE IS 17
REPORT PERIOD IS 4080

MODULE REMOVALS (ALONE + NRTS WITH ENGINE)

		* * USAGE * * *		... TIME ...			
REPORT PERIOD	K HOURS	ONE PART FAILS EARLY	MANY PARTS EARLY	MANY PRTS U+T	ONE NOT REACHED	PARTS SCREENED OUT	TOTAL
1	4080	1	1	1	0	3	6
2	8160	0	4	0	0	5	9
3	12240	0	5	1	0	2	8
4	16320	0	1	1	0	5	7
5	20400	1	2	3	0	1	7
6	24480	2	0	0	0	4	6
7	28560	2	2	1	0	3	8
8	32640	0	1	2	0	2	5
9	36720	0	2	2	0	3	7
10	40800	1	3	1	0	2	7
TOTALS		7	21	12	0	30	70

	INPUT BASE LEVEL	* * * * * FINAL BASE LEVEL	DEPOT LEVEL	TOTAL FOR CAUSE * * * * * *
REM/1000EFH	0.6100	1.1765	0.5392	1.7157
NRTS PERCENT	76.00	85.42		
% DEP REPAIR			100.00	90.00

TABLE 6

MODULE REMOVALS SUMMARY PAGE 12

DATE 110179 TIME 12.14 SEC 11

M	MODULE NOMENCLATURE	* * * PRIMARY USE	U-DEP	TIME	SCREEN * * * *	TOTAL
1	700 AUGMENTOR	73	0	0	0	73
2	100 ACC1 WLL	0	0	21	50	71
3	300 FAN	14	0	7	50	71
4	400 CORE	28	0	12	30	70
5	500 H P TURB	34	0	3	59	96
6	600 FAN DR TUR	17	0	4	46	67
7	800 GEARBOX	12	0	11	0	23
8	900 ACC2 WOLL	89	0	0	0	89
GRAND TOTAL		267	0	58	235	560

TABLE 7

PARTS REMOVAL SUMMARY PAGE 14

>>> 400 CORE

PART NO. J	PART NAME	USAGE	TOLERANCE	U-DEP	TIME	SCREEN	TOTAL	BASE SCREEN
		* * * * * * * *		REMOVALS *	* * * * * * *			
18	400 CORE DUMMY	26	0	1	12	31	70	100
19	401 4STG SEAL	0	0	0	0	15	15	470
20	402 5STG SEAL	0	0	0	0	6	6	875
21	403 6STG SEAL	0	0	0	0	18	18	410
22	404 7STG SEAL	0	0	0	0	12	12	550
23	405 8STG SEAL	0	0	0	0	44	44	280
24	406 9STG SEAL	0	0	0	0	43	43	280
25	407 10STG SEAL	0	0	0	0	44	44	280
26	408 11STG SEAL	0	0	0	0	44	44	280
27	409 12STG SEAL	0	0	0	0	43	43	280
28	410 13STG SEAL	0	0	0	0	8	8	750
29	411 4STG DISK	0	0	0	0	7	7	750
30	412 5STG DISK	0	0	0	0	9	9	650
31	413 6STG DISK	0	0	0	0	5	5	1050
32	414 7STG DISK	0	0	0	0	44	44	275
33	415 8STG DISK	0	0	0	0	23	23	375
34	416 9STG DISK	0	0	0	0	18	18	415
35	417 10STG DISK	0	0	0	0	8	8	775
36	418 11STG DISK	0	0	0	0	9	9	700
37	419 12STG DISK	0	0	0	0	13	13	575
38	420 13STG DISK	0	0	0	0	9	9	675
39	421 REAR SHAFT	0	0	0	0	8	8	775
MODULE TOTALS		26	0	1	12	461	500	

TABLE 8

OBJECTIVE FUNCTION PAGE 16

COMPLETE ENGINE MAINTENANCE COSTS

	ENGINE REMVLS	* 20/ 200	REM/REP CST/REM	AV.BASE CST/REM	AV.DEP. CST/REM	20-YEAR COSTS
BASE REMVLS	300	30.0000	161			4830
BASE RTS	278	27.8000		1558		43333
DEPOT NRTS	22	2.2000			14652	32234
GRAND TOTAL						80397

* * * * FACTORS * * * *

OBJECTIVE FUNCTION

MODULE MAINTENANCE COST WITH

ITEM	MODULE NOMENCLATURE	TOTAL NRTS MOD REMOVLS	*20/ 200	DEPOT COST FACTOR	TOTAL 20 YRS DEPOT
AUG	700 AUGMENTOR	3	0.3000	2899	869
ACC1	100 ACC1 WLL	22	2.2000	846	1861
FAN	300 FAN	22	2.2000	2667	5867
COR	400 CORE	22	2.2000	5422	11928
HPT	500 H P TURB	22	2.2000	1201	2642
FDT	600 FAN DR TUR	22	2.2000	1959	4309
GBX	800 GEARBOX	2	0.2000	755	150
ACC2	900 ACC2 WOLL	8	0.8000	124	99
				TOTAL	27725

TABLE 9

OBJECTIVE FUNCTION

COMPLETE ENGINE PIPELINE COSTS

DAILY DEMAND RATE		N R T S		B A S E		PIPELINE	STK LIST	TOTAL
REM/1000FH	*17/30000	RATE	PIPE	RATE	PIPE	QUANTITY	PRICE	COST
7.4755	0.0042361	7.2	56	92.8	4	0.08283	1700000	55816

TABLE 10

OBJECTIVE FUNCTION PAGE 17

MODULE MAINTENANCE COSTS-ALONE

ITEM	TOTAL NRTS MOD REMVLS	*20/ 200	DEPOT COST FACT	TOTAL BASE MOD REMVLS	*20/ 200	BASE COST FACT	TOTAL 20 YRS DEPOT&BASE
AUG	6	0.6000	2899	64	6.4000	775	6698
ACC1	49	4.9000	846	0	0.	846	4145
FAN	44	4.4000	2667	5	0.5000	839	12153
COR	41	4.1000	5422	7	0.7000	2500	23980
HPT	53	5.3000	1201	21	2.1000	850	8149
FDT	31	3.1000	1959	14	1.4000	536	6822
GBX	20	2.0000	755	1	0.1000	180	1527
ACC2	0	0.	124	81	8.1000	0	0
						TOTAL	63474

TABLE 11

MODULE PIPELINE COSTS

ITEM	DAILY DEMAND RATE REM/1000FH	*17/30000	NRTS PIPE	BASE PIPE	PIPELINE QTY/MOD	MODULE PRICE	COST PER MODULE
AUG	1.7157	0.0009722	41	4	0.00697	360000	2510
ACC1	1.2010	0.0006806	4	2	0.00212	0	0
FAN	1.2010	0.0006806	36	4	0.02228	177000	3943
COR	1.1765	0.0006667	48	8	0.02811	704000	19790
HPT	1.8137	0.0010278	24	5	0.01913	131028	2505
FDT	1.1029	0.0006250	29	5	0.01346	169000	2274
GBX	0.5147	0.0002917	25	2	0.00697	23000	160
ACC2	1.9853	0.0011250	0	1	0.00113	0	0
						TOTAL	31182

TABLE 11a

TRANSPORTATION COSTS

ITEM	NOMENCLATURE	NRTS REMOVALS	* 20/ 200	TRANSPT CST/REM	20-YEAR COSTS
ENG	COMPLETE ENG.	22	2.2000	5000	11000
AUG	700 AUGMENTOR	6	0.6000	2066	1239
ACC1	100 ACC1 WLL	49	4.9000	0	0
FAN	300 FAN	44	4.4000	888	3907
COR	400 CORE	41	4.1000	2013	8253
HPT	500 H P TURB	53	5.3000	423	2241
FDT	600 FAN DR TUR	31	3.1000	1107	3431
GBX	800 GEARBOX	20	2.0000	200	400
ACC2	900 ACC2 WOLL	0	0.	0	0
			MODULES TOTAL		19471
			GRAND TOTAL		30471

TABLE 12

LIFE-LIMITED PARTS REPLACEMENT COSTS
FOR 20-YEAR LIFE CYCLE

>>> 400 CORE

PART NO.	PART NAME	TOTAL SCHED RMVL(200YR)	SCHED RMVL (20YR)	UNIT PRICE	TOTAL 20-YR
18	400 CORE DUMMY	44	4.40000	0	0
19	401 4STG SEAL	15	1.50000	1093	1639
20	402 5STG SEAL	6	0.60000	1280	768
21	403 6STG SEAL	18	1.80000	1424	2563
22	404 7STG SEAL	12	1.20000	1163	1395
23	405 8STG SEAL	44	4.40000	1742	7664
24	406 9STG SEAL	43	4.30000	1118	4807
25	407 10STG SEAL	44	4.40000	3292	14484
26	408 11STG SEAL	44	4.40000	3308	14555
27	409 12STG SEAL	43	4.30000	3369	14486
28	410 13STG SEAL	8	0.80000	5283	4226
29	411 4STG DISK	7	0.70000	4708	3295
30	412 5STG DISK	9	0.90000	3893	3503
31	413 6STG DISK	5	0.50000	8134	4067
32	414 7STG DISK	44	4.40000	6764	29761
33	415 8STG DISK	23	2.30000	4448	10230
34	416 9STG DISK	18	1.80000	8549	15388
35	417 10STG DISK	8	0.80000	4441	3552
36	418 11STG DISK	9	0.90000	8448	7603
37	419 12STG DISK	13	1.30000	4641	6033
38	420 13STG DISK	9	0.90000	8486	7637
39	421 REAR SHAFT	8	0.80000	9793	7834

MODULE SUBTOTAL 165490

TABLE 13

OBJECTIVE FUNCTION SUMMARY

PAGE 21

F100-PW100(F15)

DATE 110179

TIME 12.14 SEC 11

ITEM	* * * MAINTENANCE COSTS * * * ALONE BASE	ALONE DEPOT	WITH DEPOT	TOTALS	PIPE LINE COSTS	TRANS PORT COSTS	PARTS COSTS	20-YEAR COSTS
ENG	48163		32234	80397	55816	11000		147213
AUG	4959	1739	869	7567	2510	1239	0	11316
ACC1	0	4145	1861	6006	0	0	68291	74297
FAN	419	11734	5867	18020	3943	3907	132863	158733
COR	1750	22230	11928	35908	19790	8253	165490	229441
HPT	1784	6365	2642	10791	2505	2241	119122	134659
FDT	750	6072	4309	11131	2274	3431	105421	122257
GBX	17	1510	150	1677	160	400	0	2237
ACC2	0	0	99	99	0	0	0	99
MODTOT	9679	53795	27725	91199	31182	19471	591187	733039
GRAND TOTALS				171596	86998	30471	591187	880252

TABLE 14

* SCREEN. NRTS RATE & REMOVALS PER 1000 FH *
SUMMARY

DATE 110179 TIME 12.14 SEC 11

ITEM NAME	DEPOT SCREEN INTERVAL	* I N I T I A L * NRTS RATE %	REM/ 1000 FH.	* * F I N A L * * NRTS RATE %	REM/ 1000 FH.
COMPLETE ENG.		7.00	5.7500	7.21	7.4755
700 AUGMENTOR	0	9.00	1.5067	8.57	1.7157
100 ACC1 WLL	2000	0.	0.	100.00	1.2010
300 FAN	2[illegible]0	56.00	0.3050	89.80	1.2010
400 CORE	2[illegible]0	76.00	0.6100	85.42	1.1765
500 H P TURB	2000	34.00	0.9150	71.62	1.8137
600 FAN DR TUR	25[illegible]0	36.00	0.3965	68.89	1.1029
800 GEARBOX	0	55.00	0.2989	95.24	0.5147
900 ACC2 WOLL	0	0.	1.7179	0.	1.9853

RULE OF X WAS 4

**************** NEXT SEED RUN ****************

TABLE 15

>>>> * AVERAGE DATA * <<<<

ENGINE REMOVALS PAGE 1

REPORT PERIOD SUMMARY

F100PW100 (F15)

DATE 110179 TIME 12.15 SEC 3

		INPUT	OUTPUT
SEED RUN 2			
	REM/1000EH	5.7500	7.4877
	NRTS %	7.00	5.89

SIMULATION PERIOD IS 40800
REPORT PERIOD IS 4080
LIFE PERIOD FOR OBJECTIVE FUNCTION IS 20 YEARS
MONTHLY UTILIZATION RATE IS 17 FLYING HOURS
WARMUP YES
SEED IS RANDOM
NUMBER OF MODULES 8 RULE OF X WAS 4

ENGINE REMOVALS

REPORT PERIOD K	HOURS	* * USAGE * * * ONE MOD. FAILS EARLY	MANY MODS. EARLY	... TIME ... MANY MODS. U+T	ONE MOT REACHED	TOTAL
1	4080	17	7	4	3	31
2	8160	21	3	8	3	35
3	12240	18	5	4	4	31
4	16320	23	5	5	2	35
5	20400	17	4	7	3	31
6	24480	18	4	6	2	30
7	28560	22	4	4	3	33
8	32640	14	4	5	4	27
9	36720	17	5	5	1	28
10	40800	17	5	4	3	29
TOTALS		184	46	52	28	310

SEED TOTAL 599

TABLE 15 (cont.)

>>>> * AVERAGE DATA * <<<<

MODULE REMOVALS SUMMARY PAGE 2

DATE 110179 TIME 12.15 SEC 3

M	MODULE NOMENCLATURE	USE	U-DEP	TIME	SCREEN	TOTAL
		* * * PRIMARY * * * *				
1	700 AUGMENTOR	71	0	0	0	71
2	100 ACC1 WLL	0	0	21	47	68
3	300 FAN	14	0	8	45	67
4	400 CORE	27	0	16	26	69
5	500 H P TURB	39	0	4	57	100
6	600 FAN DR TUR	15	0	4	43	62
7	800 GEARBOX	14	0	11	0	25
8	900 ACC2 WOLL	83	0	0	0	83
GRAND TOTAL		263	0	64	218	545
SEED TOTALS		522	0	127	435	1084

TABLE 15 (cont.)

>>>> * AVERAGE DATA * <<<<

OBJECTIVE FUNCTION SUMMARY PAGE 3

F10 PW100(F15)

DATE 110179 TIME 12.15 SEC 3

ITEM	* * * MAINTENANCE COSTS * * * ALONE BASE	ALONE DEPOT	WITH DEPOT	TOTALS	PIPE LINE COSTS	TRANS PORT COSTS	PARTS COSTS	20-YEAR COSTS
ENG	49235		26373	75608	50952	9000		135560
AUG	4688	1739	1159	7586	2440	1239	0	11265
ACC1	0	4230	1523	5753	0	0	65429	71182
FAN	503	11468	4800	16771	3864	3818	128518	152971
COR	1625	23857	9759	35241	21159	8857	165513	230770
HPT	1955	6966	2162	11083	2742	2453	119122	135400
FDT	563	6464	3526	10553	2369	3653	101790	118365
GBX	99	1359	75	1533	147	360	0	2040
ACC2	0	0	62	62	0	0	0	62
MODTOT	9433	56083	23066	88582	32721	20380	580372	722055
GRAND TOTALS				164190	83673	29380	580372	857615
SEED TOTALS		328367		167346	58758	1160741		1715212

>>>> * AVERAGE DATA * <<<<

* SCREEN, NRTS RATE & REMOVALS PER 1000 FH * SUMMARY

DATE 110179 TIME 12.15 SEC 3

ITEM NAME	DEPOT SCREEN INTERVAL	* I N I T I A L * NRTS RATE %	REM/ 1000 FH.	>>> * AVERAGE * <<< * * F I N A L * * NRTS RATE %	REM/ 1000 FH.
COMPLETE ENG.		7.00	5.7500	5.89	7.4877
700 AUGMENTOR	0	9.00	1.5087	9.05	1.6299
100 ACC1 WLL	2000	0.	0.	100.00	1.2255
300 FAN	2000	56.00	0.3050	87.76	1.2010
400 CORE	2000	76.00	0.6100	87.05	1.2377
500 H P TURB	2000	34.00	0.9150	71.61	1.9853
600 FAN DR TUR	2500	36.00	0.3965	76.11	1.0662
800 GEARBOX	0	55.00	0.2989	78.39	0.5760
900 ACC2 WOLL	0	0.	1.7179	0.	1.9118

RULE OF X WAS 4

SEED TOTALS NRTS % 11.79 REMOVALS 14.9755

VI. Program LAU/OMENSRUN, R

1. This program is written in FORTRAN for use on the CREATE system in AFLC. The CREATE system is a time-sharing/batch computer system which uses the H635 computer. This program is run in time-sharing and automatically spawns and executes in the background as a batch run. It is stored in file LAU, under the name OMENSRUN, and can be called after the user is logged on under the YFORT system by typing OLD LAU/OMENSRUN,R. An alternate to running OMENSRUN is to log on under the CARD system and type OLD LAU/OMENS.15 for the F15 and OLD LAU/OMENS.16 for the F16. See Chapter IV, Paragraph 4 for details.

2. Purpose of Program: This model simulates the operation of a single typical engine, F100PW100, installed in an F15 or F16 aircraft. Each engine has m modules and each module has j parts, one per module may be a dummy part which is included so that module removals not caused by one of the other j-1 parts can be accounted for. The engine removals are driven by removals required on the m modules (one of which is the engine "dummy," i.e., Accessories - 2). The module removals are driven by the part removals required on the j parts. Premature removal rate factors, initial NRTS rates, and life limits are needed as input

for the model. The model produces long run (base on input life cycle time removals), classified into usage, time, and screened out reasons for removal. Report periods are variable, also stated at input time. The model is used in (1) simulation studies whose objectives are to identify preferred opportunistic replacement policies for each module, (2) to calculate composite removals per 1000FH and corresponding aggregate NRTS rates, (3) to calculate an objective function yielding maintenance, pipeline, transportation, and parts costs for a chosen life cycle period.

3. The Dimensions and Declarations are presented at the very beginning of the program. Comment statements are used to set off different segments of the program.

4. The Main Routine starts out setting the date and time in hours, minutes, and seconds. Following this, initialization, reading input data, warmup options, and setting the Weibull Scale parameters are done. The main computations are carried out in the many GO TO statements. Refer to the comments preceding the GO TO statements to determine what that particular section of program logic computes.

5. The rest of the program contains a number of subsections and initialization logic. The following paragraphs will

provide additional comments about each of these sections.

6. Initialize Average Accumulators/Set Date and Time. This section of the program initializes the average accumulators for the averages tables. The date and time are also set in this section.

7. Read Input Data. This section of the program reads all the internal data for the program run. This data can only be changed by accessing the source deck and recompiling the program.

8. Find Scale Parameter. This subsection finds the scale parameters for the Weibull distribution to generate failures for the dummy parts within each module. The initial (unscheduled) removals per 1000 flying hours factor is needed to compute these scale values.

9. Initialize Accumulators/Define User-Inputted Run Variables. This section initializes all program accumulators and defines and reads the user-inputted run variables.

10. Initialize Failure Times and Scheduled Removal Times. This section of the program loads initial random flying hours till unscheduled removal (failure) for each part into JTTF(J) and reads each parts MOT, and converts it

to equivalent flying hours by dividing it by the conversion factor R(J), given in input.

11. Warmup. This section of the program randomizes the starting ages of each part.

12. Minimum Failure and Scheduled Time. This subsection of the program finds the part having the minimum time till failure and which has the minimum time till MOT.

13. Count Multiple Part Removals. This part of the program determines if more than one part is to be removed for failure (due to equal failure times) or more than one has the same time remaining till MOT removal.

14. Update All Parts to Remaining Time in Report Period. This section of the program simply subtracts the amount of time from all parts that were not removed in order to update them to the time that the removals of the offending parts took place.

15. Report Period Removal Tabulations.

a. This is a large section of the program that contains

logic necessary for each report period of the program run. It begins by initializing the removal code arrays for the parts and the modules. Then each part is aged by the minimum time to removal and the time remaining in this report period is decremented by that amount. This part of the program contains the coding logic for each reason for removal of the part in question.

b. Next the program assigns a removal code to all removed parts. Immediately following this logic the removal reasons for module removals are determined according to what parts were removed from these modules. When this step is accomplished, the reason for removal of the engine can be determined as well as whether or not the Rule of X Policy applies.

16. Record Engine Removals. This subsection records engine removals and module removals by report period, and separates these removals as NRTS or RTS.

17. Module Removal Summary. This subsection of the program totals all the module removal reasons by primary cause.

18. Part Removals by Cause. This section records part level removals by cause.

19. Failure and Scheduled Removal Times. This section calculates new removal times through a random number generator, UNIFM1(SEED).

20. Totals. This part of the program calculates all the output. The parts level totals, module removal totals, line totals by report period, total NRTS and RTS for modules and engine are all calculated here.

21. Output Tables. This routine generates the majority of the output tables for the program run.

22. Objective Function Logic. This part of the program computes the values needed to form the objective function.

23. Objective Function Tables. This subsection contains the necessary logic to print out the objective tables near the end of the program output.

24. Screen, NRTS, Removals per 1000 FH Summary. This section contains output logic for the summary table showing screens applied, NRTS produced, and removals obtained from the program run.

25. Averages Print Routines. This part of the program averages data generated when more than one seed run has

been requested and a random seed was chosen by the user. It averages various output including all objective function output and removals per 1000 flying hours.

26. <u>Input Data</u>. The input data is found near the end of the program. It is divided into several sections and each is discussed below.

a. <u>Names and Indices</u>. This section names each module identified in the program and each part, including dummy parts, that are used in the output. The names attempt to correlate the actual part names where possible.

b. <u>Actuarial, Pipeline, and Cost Data</u>. This section assigns values where necessary to compute costs, NRTS, and pipeline data for the program. The Design Maintenance Concept is the source for most of the actuarial and cost figures. A Weibull failure rate is assumed to obtain the shaping (SHP) parameters for the parts. All of the variables should be defined and can be found in Chapter VIII, Program Variables.

Program LAU/OMENS3,R

LAU/OMENS15S,R

(version dtd 1 Nov 79)

```
C
C DIMENSIONS AND DECLARATIONS
C
      CHARACTER ENGINE*10,MODULE*10,PART*10,VARNUR*8,SDTYP*8,XDATE*6
      CHARACTER INDATA*11,KPSCRN*8,KONPBR*8,BLKAVG*19,MODABBR*4
      PARAMETER MM=8,JJ=51,KK=10,NN=MM+1,JJJJ=JJ+9
      DIMENSION MODULE(MM),PART(JJ),JDPTSCRN(JJJJ),JBSESCRN(JJJJ)
      DIMENSION MSCRN(MM),BNRTSPC(MM),BRKFH(MM),PNRTSPC(MM)
      DIMENSION FRKFH(MM),B(JJ),SHP(JJ),XLOC(JJ),SCL(JJ),JPNOT(JJ)
      DIMENSION NGUSE1(KK),NGUSE2(KK),NGTM2(KK),NGTM1(KK)
      DIMENSION NGTOTR(KK),MRTS(MM),MUNRTS(MM),LCMCST1(MM),LCMCST2(MM
     &)
      DIMENSION MUSNRTS(MM),MSCHNRTS(MM),MSCRNRTS(MM),MTNRTS(MM)
      DIMENSION MXUNRTS(MM),MXUSNRTS(MM),MXSCUNRT(MM),MXSCRNRT(MM)
      DIMENSION MXORNRTS(MM),MODUSE1(MM,KK),MODUSE2(MM,KK)
      DIMENSION MODTM2(MM,KK),MODTM1(MM,KK),MODTOTR(MM,KK)
      DIMENSION MODSCR(MM,KK),MTUSE1(MM),MTUSE2(MM),MTTM2(MM)
      DIMENSION MTTM1(MM),MTTOTR(MM),MTSCR(MM),MUSE(MM),MUD(MM)
      DIMENSION MTM(MM),MSCR(MM),MTOTR(MM),NOT(JJ),LCMCST3(MM)
      DIMENSION JSCL(JJ),JUSE(JJ),JTM(JJ),JSCR(JJ),JTOTR(JJ)
      DIMENSION JPART(JJ),MOD(MM),JF(NN),JTOLB(JJ),JUDEP(JJ)
      DIMENSION MOBPNCST(MM),MJUSBT(MM),MJTOLBT(MM),MJUDEPT(MM)
      DIMENSION MJTMT(MM),MJSCRT(MM),MJTOTRT(MM),JMSCR(JJ,KK)
      DIMENSION JTRSCND(JJ),JTLCPCST(JJ),MGTLCPCS(MM),MODABBR(MM)
      DIMENSION MDRIPE(MM),MBPIPE(MM),MPIPCST(MM),FACNRTSW(MM)
      DIMENSION MDRCST(MM),MBSCST(MM),LCMCST(MM),BLCPSCND(JJ)
      DIMENSION DLCMDDR(MM),PIPEOTTM(MM),FACNNRTS(MM),FACNRTS(MM)
      DIMENSION JTTF(JJ),JTTL(JJ),MSLP(MM),JSLP(JJ),MNRTSVTH(MM)
      DIMENSION FRKFHD(MM),FRKFHC(MM),DEPPC(MM),TOTPC(MN),LCST4(MM)
      DIMENSION MAUSE(MM),MAUD(MM),MATM(MM),MASCR(MM),LXCST1(MM)
      DIMENSION MXGPCS(MM),MXPIP(MM),LXCST4(MM),LXCST3(MM),LXCST(MM)
      DIMENSION NGU1(KK),NGU2(KK),NGT1(KK),NGT2(KK),PNRTS(MM),FRFN(MM
     &)
      DIMENSION MTRCST(MM),MBSEPMN(MM),LCMTRANS(MM),MXTRCST(MM),LXCST
     &2(MM)
C
C
C * * * * M A I N * * * * * * * *
C
C SET DATE AND TIME
      GOTO 1000
C
C  READ INPUT DATA
C
 1500 GOTO 9000
C
C FIND SCALE PARAMETER FOR WEIBULL DISTRIBUTION
 8900 DO 9 I = 1,MM
      IF (BRKFH(I).LE. 0.001) GO TO 8
      JSCL(JF(I)) = IFIX(ALOC(JF(I))+(((1000.0/BRKFH(I))-ALOC(JF(I)))
     &)/
     &(GAMF((1.0/SHP(JF(I)))+1.0))))
```

```
      GOTO 9
    8 JSCL(JP(I)) = 990000
    9 CONTINUE
C INITIALIZE ALL ACCUMULATORS AND DEFINE USER-INPUTTED RUN VARIABLES
      GOTO 750
C
C INITIALIZE JTTF(J) AND JTTL(J) FOR ALL J PARTS
C
  200 GO TO 2100
C
C WARMUP DESIRED?
C
  240 IF(KW.NE.1) GO TO 1
C
C WARMUP
C
  250 GO TO 4100
C
C SCALE REPORT PERIOD COUNTERS
C INTERVAL WIDTH = INPUT REPORT PERIOD
C
  199 KLAST = (FLOAT(ISIMPRD)/FLOAT(IRPTPRD))+.9
      IF(KLAST.LE.KK)  GO TO 200
      PRINT 1483
 1483 FORMAT(" ","PARAMETER KK IN LINES 1030 AND 1480 TOO SMALL")
      STOP
C
C FOR EACH REPORT PERIOD, K
C
C * * * * * * * * * * * * * * * * * * * * * * * * * *
    1 DO 100 K = 1,KLAST
C * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C FIND MIN TIME TIL FAILURE AND MIN TIME TIL LIMIT
C
    5 GOTO 4200
C
C COUNT MULTIPLE PARTS REMOVALS
C
   10 GO TO 4300
C
C REMOVALS THIS REPORT PERIOD?
C
   20 IF(MINF.LT.K3) GO TO 40
      IF(MINL.LT.K3) GO TO 40
C
C NO REMOVALS THIS REPORT PERIOD
C
C UPDATE ALL PARTS FOR REMAINING TIME IN THIS K PERIOD
      GO TO 4400
C
C
```

```
   35 GO TO 100
C
C CODE REASONS FOR REMOVAL FOR PARTS, MODULES, AND
C FOR ENGINE, AND APPLY SCREENS AND TOLERANCE INTERVALS
C AND REPLACE REMOVED PARTS
C
   40 GO TO 5600
C
C RECORD ALL PARTS, MODULES, ENGINE REMOVALS
C ENGINE REMOVALS BY REPORT PERIOD, K
C
   50 GO TO 5100
C
C MODULE REMOVALS FOR ENGINE NRTS ANALYSIS REPORTS
C
   60 GO TO 5105
C
C MODULE REMOVALS BY REPORT PERIOD, K
C
   70 GO TO 5135
C
C MODULE REMOVAL SUMMARY BY CAUSE
C
   80 GO TO 5145
C
C PART REMOVALS BY CAUSE
C
   90 GO TO 5155
C
C REPLACE REMOVED PARTS
C
   95 GO TO 5200
C
C FIND TIME TO NEXT REMOVAL OF ENGINE, MODULES, PARTS
C
   97 GO TO 5
C NEXT K PERIOD
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * *
  100 CONTINUE
C * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C PRE-OUTPUT - REMOVAL TABLES
C
      GO TO 5300
C
C OUTPUT -- REMOVAL TABLES
C
  105 GO TO 5600
C
C PRE-OUTPUT -- OBJECTIVE FUNCTION
C
```

```
      106 GO TO 7300
C
C OUTPUT -- OBJECTIVE FUNCTION
C
      107 GO TO 7400
C
C OUTPUT -- SCREEN, NRTS, REM/1000FH SUMMARY AND ACTUARIAL INPUT
C
      108 GO TO 8200
C
C
C
     9992 IF(ISMAX.EQ.1) GO TO 9998
          GO TO 8600
C
C  AVERAGES PRINT ROUTINES
C
     9993 IAVG=IAVG+1
          PRINT 9994
     9994 FORMAT("1",T25,">>>> * AVERAGE DATA"," * <<<<")
C
          IF(IAVG.EQ.1) GO TO 1030
          IF(IAVG.EQ.2) GO TO 8400
          IF(IAVG.EQ.3) GO TO 8100
          GO TO 9999
C
C  HALF PAGE AVERAGES
C
     9995 PRINT 9996
C
     9996 FORMAT("0",T25,">>>> * AVERAGE DATA"," * <<<<")
C
          GO TO 8208
C
C  PRINT INPUT DATA
C
C
C
C END OF COMPUTATION
C
     9998 GO TO 9999
C
C * * * * END OF MAIN * * * * *
C
C INITIALIZE AVERAGES ACCUMULATORS
C
     1000 IAVG=0
          BLKAVG="                    "
C
          ISDRUN = 0
     1020 ISDRUN = ISDRUN + 1
C SET DATE AND TIME
```

```
C
      CALL ADATE(XDATE)
 1030 CALL TIME(ITIME)
      FTIME = FLOAT(ITIME)/10**7
      HTIME = FLOAT(ITIME)/10**5
      KTIME = IFIX(HTIME)*100
      STIME = FLOAT(ITIME)/10**3
      JTIME = IFIX(STIME)
      LTIME = JTIME-KTIME
      IF(LTIME.GT.49) FTIME = FTIME+.01
C
 1040 IPG = 0
C
 1050 IF(IAVG.EQ.1) GO TO 5700
C
      IF (ISDRUN.GT.1) GO TO 1100
C
C
C
      GOTO 1500
C
C
C COMPUTE MONTHLY UTILIZATION FACTOR
C
  750 DCONVR = 1000.0*30.0
      IDCR = IFIX(DCONVR)
C
C - - SCREEN POLICIES - -
C
      DATA(MSCRN(I),I=1,8)/8*450/
      DATA(JPMOT(I),I=1,49)/49*0/
C
C RUN VARIABLES DEFINED
C
C ISIMYRS=TOTAL NUMBER OF SIMULATION YEARS
C ISIMPRD=NUMBER OF SIMULATION YEARS IN SIMULATION PERIOD
C MONUTR=MONTHLY UTILIZATION RATE; IRPTPRD=NUMBER YRS IN REPORT PERIOD
C ISDRUN=NUMBER OF SEED RUNS;   COUNTS UP TO ISMAX
C ISMAX=TOTAL NUMBER OF SEED RUNDS DONE
C LFCYC=LIFE CYCLE; JTOL=TOLERANCE VALUE
C SDTYP=SEED TYPE; MRULE=RULE OF X VALUE
C IP=PRINT INDICATOR,LONG RUN=0,SHORT RUN=1
C
C - - RUN VARIABLES - - - - - - - - - - - - - - - - - - - - - -
C
      ISIMYRS = 200; MONUTR = 17 ; ISDRUN = 1  ; NPI = 0 ;IAVG=0
      ISIMPRD = 0 ;  LFCYC = 15 ;  ISMAX = 1
      SDTYP = "FIXED";  MRULE = 4 ;  IRPTPRD = 0  ;  IP = 0
C SET KW = 0 IF NO WARMUP IS DESIRED, OR 1 IF WARMUP
      KW = 1
C  SET KS = 0 IF STANDARD SEED IS DESIRED, OR 1 IF RANDOM
      KS = 1
```

```
C
      READ 32,MRULE,ISMAX,IP,KS,KW,LFCYC,ISIMYRS,MONUTR,
     &JTOL,FACT
   32 FORMAT(I1,1X,I1,1X,I1,1X,I1,1X,I1,1X,I2,1X,I3,1X,I2,
     &1X,I3,1X,F3.1)
C
      PRINT 34,MRULE,ISMAX,IP,KS,KW,LFCYC,ISIMYRS,MONUTR,JTOL,FACT
   34 FORMAT("0","VALUES INPUT ",I1,1X,I1,1X,I1,1X,
     &I1,1X,I1,1X,I2,1X,I3,1X,I2,1X,I3,1X,F3.1)
      DO 41 I=1,8
      L1=I*7 - 6;    L2=I*7
      READ 37,(JBSESCRN(J),JDPTSCRN(J),J=L1,L2)
   41 PRINT 37,(JBSESCRN(J),JDPTSCRN(J),J=L1,L2)
   37 FORMAT(14I5)
C
      WARMUP = "NO" ; SEED = 19.0 ; KPSCRN = "CONSTANT"
      KONPEN = "CONSTANT"
      IF(KW.EQ.1) WARMUP = "YES"
      IF(KS.EQ.1) SEED = FTIME
      IF(KS.EQ.1) SDTYP = "RANDOM"
      ISIMPRD = ISIMYRS*MONUTR*12
      IRPTPRD = ISIMPRD/KK
C
      IF(ISMAX.EQ.0) GO TO 870
C
  800 IF(KP1.EQ.0) GO TO 850
      KNT = 0
      DO 810 M=1,MM
      IF(JDPTSCRN(M).LT.0) KNT = KNT+1
  810 CONTINUE
      IF(KNT.GT.0)  GO TO 880
C
  820 PMOT = 0
      DO 840 M = 1,MM
      DO 830 J = JF(M),(JF(M+1)-1)
      PMOT = FLOAT(JDPTSCRN(JF(M)))/100.0*FLOAT(MOT(J))*FACT
      JPMOT (J) = IFIX(PMOT)
  830 CONTINUE
      MSCRN (M) = IFIX(PMOT)
  840 CONTINUE
      GO TO 900
C
  850 DO 860 M=1,8
      MSCRN (M) = JDPTSCRN(JF(M))
  860 CONTINUE
      GO TO 900
  870 PRINT 872
  872 FORMAT("0","ISMAX IN ERROR ")
      GO TO 9999
  880 PRINT 885,KNT
  885 FORMAT("0",I4,2X,"PERCENT VALUES EXCEED 100 OR NEGATIVE")
      GO TO 9999
```

```
      C
      C INITIALIZE ACCUMULATORS
      C
        900 IAOBGTOT=0;NXTRAN=0;MAUSET=0;MAUDT=0;MATMT=0;MASCRT=0
            IXCST=0;IXPIP=0;IXPART=0;NXPIP=0;NXPCST=0;MXPIPT=0;LXCMST=0
            LXCMST3=0;LXCMST4=0;LXRCST=0;IXBFNT=0;NXBEN=0;MXTRAN=0;NXBERO=
           &0
            ENRTSPCT=0;ERKPHT=0;EAPH=0;EXNRTS=0;IOBFNBX=0;MXTOT=0;NXBASE=0
            DO 950 M=1,MM
            MAUSE(M)=0;MAUD(M)=0;MATM(M)=0;MASCR(M)=0;LXCST1(M)=0
            MXGPCS(M)=0;NXPIP(M)=0;LXCST8(M)=0;LXCST3(M)=0;LXCST(M)=0
            FNRTS(M)=0;FKPH(M)=0;LXCST2(M)=0;MXTRCST(M)=0
        950 CONTINUE
      C
      C
            DO 975 K=1,KK
            NGU1(K)=0;NGU2(K)=0;NGT1(K)=0;NGT2(K)=0
        975 CONTINUE
      C
      C
      C SUBSECTION 1100
      C
      C INITIALIZE TABLES AND ACCUMULATORS
      C VARIABLES RELATED TO REPORT PERIODS, K
      C
       1100 DO 1115 K = 1,KK
            NGUSE1(K) = 0;NGUSE2(K)=0;NGTM2(K)=0;NGTM1(K)=0
            NGTOTM(K)=0
       1115 CONTINUE
      C
      C VARIABLES RELATED TO BOTH MODULES,M,AND REPORT PERIODS,K
      C
       1120 DO 1150 M = 1,MM
       1130 DO 1140 K = 1,KK
            MODUSE1(M,K)=0;MODTM2(M,K)=0;MODTM1(M,K)=0;MODTOTR(M,K)=0
            MODSCR(M,K)=0;MODUSE2(M,K)=0
       1140 CONTINUE
       1150 CONTINUE
      C
      C VARIABLES RELATED TO MODULES ALONE, M
      C
       1160 DO 1170 M = 1,MM
            MRTS(M)=0;MUNRTS(M)=0;MUSNRTS(M)=0;MSCNRTS(M)=0
            MSCRNRTS(M)=0;MXUNRTS(M)=0;MXUSNRTS(M)=0;MXSCRNRT(M)=0
            MXSCRNRT(M)=0;MXOKNRTS(M)=0;MUSE(M)=0;MUD(M)=0;MTM(M)=0
            MSCR(M)=0;MNRTSWTH(M)=0;LCMCST1(M)=0; LCMCST2(M)=0
            LCMCST3(M)=0;LCST4(M)=0;LCMTRANS(M)=0;LCMCST(M)=0
       1170 CONTINUE
      C
      C VARIABLES RELATED TO PARTS, J
      C
       1180 DO 1190 J = 1,JJ
```

```
      JUSE(J)=0;JTM(J)=0;JSCR(J)=0;JTOLR(J)=0;JUDEP(J)=0
 1190 CONTINUE
C
C INITIALIZE TIME REMAINING THIS REPORT PERIOD
C
      ICLOCK = 0
      KS = IRPTPRD
C
C UNSUBSCRIPTED ACCUMULATORS
C
      NENGTOT = 0; NUC=0; NRX=0; NENGNRTS=0; NBSEPTMN=0
C
C VARIABLES RELATED TO BOTH J AND K
C
      DO 1195 K = 1,KK
      DO 1196 J = 1,JJ
      JMSCR(J,K)=0
 1196 CONTINUE
 1195 CONTINUE
C
C RETURN
C
      GO TO 199
C
C SUBSECTION 2100
C
C INITIALIZE TIME TIL FAILURE,JTTF(J),AND TIME TIL LIFE
C LIMIT, JTTL(J), FOR EACH PART J
C
C LOAD RANDOM FLYING HOURS TIL UNSCHEDULED REMOVAL (FAILURE)
C FOR EACH PART INTO JTTF(J), AND READ EACH PART'S
C MAXIMUM OPERATING TIME, MOT(J), AND CONVERT TO EQUIVALENT
C FLYING HOURS BY DIVIDING BY CONVERSION FACTOR, R(J), GIVEN
C IN INPUT. SUBSECTION AT 4000 DOES THIS, AND IS USED
C THROUGHOUT THE PROGRAM WHENEVER A PART IS REPLACED
C
 2100 DO 2200 J = 1,JJ
      SCLE = FLOAT(JSCL(J))
      TTF=ALOC(J)+(SCLE-ALOC(J))*(-ALOG(UNIFM1(SEED)))**(1./SHP(J))
      JTTF(J) = IFIX(TTF)
      JTTL(J)=IFIX(FLOAT(MOT(J))*FACT/R(J))
 2200 CONTINUE
C
C RETURN
C
 2300 GOTO 200
C
C LOAD NEXT REMOVAL TIMES FOR PART J
C
C THIS SUBSECTION ASSUMES A WEIBULL DISTRIBUTION OF
C FAILURE. EACH EXECUTION OF THIS SUBSECTION LOADS A TIME-
C TIL-FAILURE, JTTF(J), AND A TIME-TIL-LIFE-LIMIT, JTTL(J),
```

```
C FOR EACH PART J.  ALL TIMES ARE CONVERTED TO EQUIVALENT
C ENGINE FLYING HOURS.  ALL TIMES ASSUME THAT A ZERO AGE
C PART WAS INSTALLED.  JTTF(J) IS THE FLYING HOUR TIME-TIL-
C NEXT-FAILURE FOR PART J.  JTTL(J) IS THE FLYING HOUR TIME-
C TIL-LIFE LIMIT FOR PART J.
C R(J) IS RATIO OF EITHER TOTAL ENGINE OPERATING HOURS TO
C ENGINE FLYING HOURS OR OF CYCLES PER FLYING HOUR AS APPRO-
C PRIATE FOR EACH PART J.
C MOT(J) IS INPUT LIFE LIMIT  (MAXIMUM OPERATING TIME) FOR
C PART J IN EITHER TOTAL OPERATING HOURS OR CYCLES AS APP.
C SHP(J) IS WEIBULL SHAPE PARAMETER (.GE.1.00) .
C IF 1.0, FAILURE DISTRIBUTION IS EXPONENTIAL (CONSTANT
C ACTUARIAL REMOVAL RATE).  AS SHP(J) INCREASES IN RANGE >
C 1.0, < INFINITY, THE FAILURE DISTRIBUTION REFLECTS ACTUARIAL
C REMOVAL RATES THAT INCREASE WITH ENGINE AGE. THE LARGER
C ACTUARIAL RATES AT HIGHER AGES.
C JSCL(J) IS THE WEIBULL SCALE PARAMETER.  THIS IS SIMILAR
C TO AN ACTUARIAL LIFE EXPECTANCY FOR PART J.
C ALOC(J) IS THE WEIBULL LOCATION PARAMETER.  IN MOST CASES
C THIS PARAMETER WILL BE 0.  ALL PARAMETERS ARE DEFINED IN
C THE INPUT DATA IN SUBSECTION 9000.
C
C SCLE = FLOAT(JSCL(J))
C  TTF =ALOC(J)+(SCLE-ALOC(J))*(-ALOG(UNIFM1(SEED)))**(1./SHP(J))
C JTTF(J) = IFIX(TTF)
C JTTL(J)=IFIX(FLOAT(MOT(J))*FACT/R(J))
C
C RETURN
C
C SUBSECTION 4100
C
C WARMUP
C
C THIS PROGRAM RANDOMIZES THE STARTING AGE OF EACH PART BY
C SUBTRACTING OFF A RANDOM SHARE OF THE TIME TIL
C FAILURE (OR TIME TO LIFE LIMIT , IF SMALLER).
C
 4100 DO 4120 J = 1,JJ
      RND = UNIFM1(SEED)
      IWS = IFIX(RND*FLOAT(JTTF(J)))
      IF(JTTF(J).GT.JTTL(J)) IWS = IFIX(RND*FLOAT(JTTL(J)))
      JTTL(J) = JTTL(J) - IWS
      JTTF(J) = JTTF(J) - IWS
 4120 CONTINUE
C
C RETURN
C
      GO TO 1
C
C SUBSECTION 4200
C
C FIND MIN JTTF(J) AND MIN JTTL(J)
```

```
C
 4200 MINF = 10000000
      DO 4210 J = 1,JJ
      IF(JTTF(J).LT.MINF)  MINF = JTTF(J)
 4210 CONTINUE
      MINL = 10000000
      DO 4220 J = 1,JJ
      IF(JTTL(J).LT.MINL)  MINL = JTTL(J)
 4220 CONTINUE
C
C RETURN
C
      GO TO 10
C
C SUBSECTION 4300
C
C COUNT MULTIPLE PART REMOVALS
C
 4300 MULTF = 0; MULTL = 0
      DO 4340 J = 1,JJ
      IF(MINF.EQ.JTTF(J))  MULTF = MULTF + 1
      IF(MINL.EQ.JTTL(J))  MULTL = MULTL + 1
 4340 CONTINUE
C
C RETURN
C
      GO TO 20
C
C SUBSECTION 4400
C
C UPDATE ALL PARTS FOR REMAINING TIME IN THIS K PERIOD
C
 4400 DO 4410 J = 1,JJ
      JTTF(J) = JTTF(J) - K3
      JTTL(J) = JTTL(J) - K3
 4410 CONTINUE
C
C RELOAD FULL TIME TO END OF REPORT PERIOD FOR NEXT K PERIOD
C
      K3 = IRPTPRD
C
C RETURN
C
      GO TO 35
C
C SUBSECTION 4600
C
C IF REMOVAL THIS PERIOD
C
C INITIALIZE REMOVAL CODE ARRAYS, JPART(J) AND MOD(M),
C AND NERC
C
```

```
 4600 DO 4610 J = 1,JJ
      JPART(J) = 0
 4610 CONTINUE
      NERC = 0
      DO 4620 M = 1,MM
      MOD(M) = 0
 4620 CONTINUE
C
C AGE EACH PART BY MIN TIME TO REMOVAL AND UPDATE TIME
C REMAINING THIS REPORT PERIOD,K3
C
      DO 4640 J = 1,JJ
      IF(MINL.LT.MINF)  GO TO 4630
      JTTF(J) = JTTF(J) - MINF
      JTTL(J) = JTTL(J) - MINF
      GO TO 4640
C SUBTRACT MINIMUM TIME TO REMOVAL FROM ALL FAILURE
C TIMES AND MOT'S FOR ALL PARTS
 4630 JTTF(J) = JTTF(J) - MINL
      JTTL(J) = JTTL(J) - MINL
 4640 CONTINUE
      IF(MINL.LT.MINF) ICLOCK=ICLOCK+MINL
      IF(MINL.GE.MINF) ICLOCK=ICLOCK+MINF
      IF(MINL.LT.MINF)  K3=K3-MINL
      IF(MINL.GE.MINF)  K3=K3-MINF
C
C FOR EACH PART, IDENTIFY AND CODE REASON FOR REMOVAL
C   CODE 0 = NO DEFECT
C   CODE 1 = USAGE REMOVAL
C   CODE 2 = TOLERANCE REMOVAL (PART IS ABOUT TO FAIL AND IS
C            DETECTED BY MAINTENANCE PERSONNEL)
C   CODE 3 = SCREENED TO DEPOT BECAUSE "CLOSE ENOUGH" TO LIFE
C            LIMIT
C   CODE 4 = LIFE LIMIT REACHED, MOT (MAX OP. TIME) REMOVAL
C   CODE 5 = U-DEP, USAGE REMOVAL, BUT "CLOSE ENOUGH" TO NOT
C            TO SEND TO DEPOT FOR REPAIR
C   CODE 6 = MULTIPLE PARTS, ALL USAGE
C   CODE 7 = MULTIPLE PARTS, WITH AT LEAST ONE SCHEDULED
C   CODE 8 = RULE OF X TO DEPOT
C   CODE 9 = MULTIPLE MODULE REMOVALS, ALL USAGE, NOT RULE OF X
C   CODE 10= MULTIPLE MODULE REMOVALS, AT LEAST ONE SCHEDULED,
C            NOT RULE OF X
C
C JF(M) IS NUMBER OF 1ST PART IN MTH MODULE.  JF(M) ARRAY
C MUST CONTAIN ONE MORE ENTRY THAN NUMBER OF MODULES.  THE
C (M+1)ST ENTRY SHOULD EQUAL ONE PLUS MTH ENTRY INPUT IN SUBS 9000.
C
      NONRTFLG = 1
      DO 4750 M = 1,MM
      DO 4700 J = JF(M),(JF(M+1)-1)
      IF(JTTL(J).EQ.0)  JPART(J) = 4
      IF (JPART(J).EQ.4)  NONRTFLG = 2
```

```
          IF(JTTL(J).EQ.0)  GO TO 4700
          IF(JTTF(J).EQ.0) JPART(J) = 1
          IF(JTTF(J).GT.0.AND.JTTF(J).LE.JTOL)  JPART(J) = 2
 4700     CONTINUE
 4750     CONTINUE
          IF (NONRTFLG.NE.1) GO TO 4751
          IF (100.0*UNIFM1(SEED).LT.PERRTSPC)  NERC = 8
C
 4751     CONTINUE
C FOR EACH MODULE, IDENTIFY AND CODE REASON FOR REMOVAL
C
          DO 4800 M = 1,MM
C
C INITIALIZE MULTIPLE PARTS COUNTER, MPC, AND COMPUTE ITS VALUE
C
          MPC=0
          DO 4810 J = JF(M),(JF(M+1)-1)
          IF (JPART(J).GT.0.OR.JTTL(J).LT.JBSESCRN(J)) MPC=MPC+1
 4810     CONTINUE
C
C FOR EACH MODULE, SIFT PARTS REASONS FOR REMOVAL
C AND CODE REASON FOR MODULE REMOVAL INTO MOD(M)
C
          DO 4850 J = JF(M),(JF(M+1)-1)
          IF(JPART(J).EQ.0)  GO TO 4850
          IF(MPC.GT.1)  GO TO 4828
          MOD(M) = JPART(J)
          GO TO 4850
 4828     IF(JPART(J).LE.2.AND.MOD(M).LT.7)  MOD(M) = 6
          IF(JPART(J).GT.2.AND.JPART(J).LT.6)  MOD(M) = 7
 4850     CONTINUE
          IF (MOD(M).NE.0) GO TO 4800
          DO 4825 J = JF(M),(JF(M+1)-1)
          IF (JTTL(J).GT.JBSESCRN(J)) GO TO 4825
          MOD(M) = 3
          GO TO 4800
 4825     CONTINUE
 4800     CONTINUE
          IF (NERC.EQ.8) NUC=NUC+1
          IF (NERC.EQ.8) GO TO 11
C CHECK FOR RULE OF X
          IMMC=0;  MMC=0
          DO 4900 M=1,MM-1
          IF (MOD(M).EQ.0.OR.M.EQ.2) GO TO 4900
          MMC=MMC+1
          IF (M.GT.2.AND.M.LT.7)  IMMC=IMMC+1
 4900     CONTINUE
          IF (IMMC.GE.3.AND.MMC.GE.MRULE)  NERC =8
          IF (NERC.EQ.8) NRX=NRX+1
   11     DO 12 M=1,MM
          IF (NERC.NE.8.AND.MOD(M).EQ.0) GO TO 12
          IF (NERC.EQ.8) GO TO 13
```

```
      IF (MOD(M).EQ.3.OR.MOD(M).EQ.4.OR.MOD(M).EQ.7) GO TO 13
C APPLY MODULE NRTS
      IF (100.0*UNIFM1(SEED).LT.BNRTSPC(M)) GO TO 13
C APPLY BASE SCREEN
      DO 15 J = JF(M),(JF(M+1)-1)
      IF (JTTL(J).GT.JBSESCRN(J)) GO TO 15
      IF (JTTF(J).EQ.0) JPART(J)=5
      GO TO 13
   15 CONTINUE
      GO TO 12
C APPLY DEPOT SCREEN
   13 DO 17 J=JF(M),(JF(M+1)-1)
      LAST=JPART(J)
      IF (JPART(J).EQ.0.AND.JTTL(J).LE.JDPTSCRN(J)) JPART(J)=3
      IF (JPART(J).EQ.2.AND.JTTL(J).LE.JDPTSCRN(J)) JPART(J)=3
      IF(MOD(M).EQ.4.AND.JPART(J).EQ.5) MOD(M)=7
      IF (MOD(M).EQ.1.AND.JPART(J).EQ.3) MOD(M)=6
      IF (MOD(M).EQ.2.AND.JPART(J).EQ.3.AND.LAST.NE.2) MOD(M)=6
      IF (MOD(M).EQ.0.AND.JPART(J).EQ.3)   MOD(M)=3
   17 CONTINUE
   12 CONTINUE
C
C
      IF (NERC.EQ.8) GO TO 5100
      IF (MMC.GT.1) GO TO 3621
      DO 4940 M=1,MM
 4940 IF (MOD(M).GT.0) NERC=MOD(M)
      GO TO 4935
 3621 NERC=9
      DO 3622 M=1,MM
      IF (MOD(M).EQ.4.OR.MOD(M).EQ.7) NERC=10
 3622 CONTINUE
C IF NERC=8, BYPASS ENGINE BASE SEPARATION COST
C BECAUSE WHOLE ENGINE SHIPPED TO DEPOT WITH NO
C MODULES REMOVED AT BASE
 4950 IF (NERC.EQ.8) GO TO 5100
 4935 CONTINUE
      IF(MMC.GT.1) GO TO 5010
C SINGLE MODULE REMOVAL
C
C COMPUTE TOTAL MANHOURS SPENT REMOVING LONE MODULE
C
      DO 5020 M = 1 , MM
      IF (MOD(M).GT.0) NBSEPTMH = NBSEPTMH + NBSEPMH(M)
 5020 CONTINUE
      GO TO 5030
 5010 IF(MOD(4).EQ.0) GO TO 5040
C COMPUTE TOTAL MANHOURS USED FOR
C MULTIPLE MODULE REMOVAL INCLUDING CORE
C
      NBSEPTMH = NBSEPTMH + NBSEPMH(4)
      IF(MOD(5).GT.0)  NBSEPTMH = NBSEPTMH + 10
```

```
      GO TO 5070
 5040 IF(MOD(5).EQ. 0) GO TO 5050
C MULTIPLE MODULE REMOVAL INCLUDING HPT BUT NOT CORE
      NBSEPTMH = NBSEPTMH + MBSEPMH(5)
      IF (MOD(3).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(3)
      IF(MOD(7).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(7)
      GO TO 5070
 5050 IF(MOD(6).EQ.0) GO TO 5060
C MULTIPLE MODULE REMOVAL INCLUDING TURBINE BUT NOT CORE NOR HPT
      NBSEPTMH = NBSEPTMH + MBSEPMH(6)
      IF(MOD(2).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(2)
      IF (MOD(3).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(3)
      IF (MOD(7).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(7)
      GO TO 5070
C MULTIPLE MODULE REMOVALS BUT NOT CORE NOR HPT NOR TURBINE
 5060 IF(MOD(1).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(1)
      IF(MOD(2).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(2)
      IF(MOD(3).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(3)
      IF(MOD(7).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(7)
C ACC2 REPAIR
 5070 IF(MOD(8).GT.0) NBSEPTMH = NBSEPTMH + MBSEPMH(8)
C ADD MH TO TEST ENGINE
 5030 NBSEPTMH = NBSEPTMH + NBTESTMH
C CONVERT MH TO DOLLARS
      NBSEPCST = IFIX((FLOAT(NBSEPTMH)*BMHCST)+.5)
C BYPASS SINCE ENGINE SHIPPED RULE OF X AND NO MODULES WERE REMOVED AT
C BASE.
C RETURN
 5090 GO TO 50
C
C SUBSECTION 5100
C
C RECORD ENGINE REMOVAL
C
C BY REPORT PERIOD, K
C
 5100 IF(NERC.EQ.1)  NOUSE1(K) = NOUSE1(K) + 1
      IF(NERC.EQ.2)  NOUSE1(K) = NOUSE1(K) + 1
      IF(NERC.EQ.4)  NOTH1(K) = NOTH1(K) + 1
      IF(NERC.EQ.5)  NOUSE1(K) = NOUSE1(K) + 1
      IF(NERC.EQ.6)  NOUSE1(K) = NOUSE1(K) + 1
      IF(NERC.EQ.7)  NOTH1(K) = NOTH1(K) + 1
      IF(NERC.EQ.8)  NOTH2(K) = NOTH2(K) + 1
      IF(NERC.EQ.9)  NOUSE2(K) = NOUSE2(K) + 1
      IF(NERC.EQ.10)  NOTH2(K) = NOTH2(K) + 1
      NENGTOT = NENGTOT + 1
C
C RETURN
C
      GO TO 50
C
C RECORD MODULE REMOVALS FOR ENGINE WRTS ANALYSES
```

```
C
 5105 IF(NEMC.EQ.8)  GO TO 5120
C
C NOT RULE OF X
C
      DO 5110 M = 1,MN
      IF(MOD(M).EQ.0)  GO TO 5110
      IF(MOD(M).EQ.1)  GOTO 5115
      IF(MOD(M).EQ.2)  GO TO 5115
      IF(MOD(M).EQ.3)  MSCRNRTS(M) = MSCRNRTS(M) + 1
      IF(MOD(M).EQ.4)  MSCHNRTS(M) = MSCHNRTS(M) + 1
      IF(MOD(M).EQ.5)  MUSNRTS(M) = MUSNRTS(M) + 1
      IF(MOD(M).EQ.7)  MSCHNRTS(M) = MSCHNRTS(M) + 1
      IF(MOD(M).EQ.6) GO TO 5115
      GOTO 5110
C
C SEPARATE INTO RTS OR NRTS REMOVAL
C
 5115 RND = UNIFN1(SEED)*100.0
      IF(RND.GT.BNRTSPC(M))  NRTS(M) = NRTS(M) + 1
      IF(RND.LE.BNRTSPC(M))  MUNRTS(M) = MUNRTS(M) + 1
 5110 CONTINUE
C
C RETURN
C
      GOTO 70
C
C RULE OF X
C
 5120 NENGNRTS = NENGNRTS + 1
      DO 5130 M = 1,MN
      IF(MOD(M).EQ.0)  MXOKNRTS(M) = MXOKNRTS(M) + 1
      IF(MOD(M).EQ.1)  MXUNRTS(M) = MXUNRTS(M) + 1
      IF(MOD(M).EQ.2)  MXUNRTS(M) = MXUNRTS(M) + 1
      IF(MOD(M).EQ.3)  MXSCRNRT(M) = MXSCRNRT(M) + 1
      IF(MOD(M).EQ.4)  MXSCHNRT(M) = MXSCHNRT(M) + 1
      IF(MOD(M).EQ.5)  MXUSNRTS(M) = MXUSNRTS(M) + 1
      IF(MOD(M).EQ.6)  MXUNRTS(M) = MXUNRTS(M) + 1
      IF(MOD(M).EQ.7)  MXSCHNRT(M) = MXSCHNRT(M) + 1
 5130 CONTINUE
C
C RETURN
C
      GO TO 70
C
C RECORD MODULE LEVEL REMOVALS
C
C BY REPORT PERIOD, K
C
 5135 DO 5140 M = 1,MN
      IF(MOD(M).EQ.0)  GO TO 5140
      IF(MOD(M).EQ.1)  MODUSE1(M,K) = MODUSE1(M,K) + 1
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      IF(MOD(M).EQ.2)  MODUSE1(M,K) = MODUSE1(M,K) + 1
      IF(MOD(M).EQ.3)  MODSCR(M,K) = MODSCR(M,K) + 1
      IF(MOD(M).EQ.4)  MODTM1(M,K) = MODTM1(M,K) + 1
      IF(MOD(M).EQ.5)  MODTM1(M,K) = MODTM1(M,K) + 1
      IF(MOD(M).EQ.6)  MODUSE2(M,K) = MODUSE2(M,K) + 1
      IF(MOD(M).EQ.7)  MODTM2(M,K) = MODTM2(M,K) + 1
 5140 CONTINUE
C
C RETURN
C
      GO TO 90
C
C SUBSECTION 5145
C
C MODULE REMOVAL SUMMARY ( FOR PRIMARY CAUSE)
C
 5145 DO 5150 M = 1,MM
      IF(MOD(M).EQ.0)  GO TO 5150
      IF(MOD(M).EQ.1)  MUSE(M) = MUSE(M) + 1
      IF(MOD(M).EQ.2)  MUSE(M) = MUSE(M) + 1
      IF(MOD(M).EQ.3)  MSCR(M) = MSCR(M) + 1
      IF(MOD(M).EQ.4)  MTM(M) = MTM(M) + 1
      IF(MOD(M).EQ.5)  MUD(M) = MUD(M) + 1
      IF(MOD(M).EQ.6)  MUSE(M) = MUSE(M) + 1
      IF(MOD(M).EQ.7)  MTM(M) = MTM(M) + 1
 5150 CONTINUE
C
C RETURN
C
      GO TO 90
C
C SUBSECTION 5155
C
C RECORD PART LEVEL REMOVALS BY CAUSE
C
 5155 DO 5160 J = 1,JJ
      IF(JPART(J).EQ.0)  GO TO 5160
      IF(JPART(J).EQ.1)  JUSE(J) = JUSE(J) + 1
      IF(JPART(J).EQ.2)  JTOLR(J) = JTOLR(J) + 1
      IF(JPART(J).EQ.3)  JSCR(J) = JSCR(J) + 1
      IF(JPART(J).EQ.3)  JMSCR(J,K) = JMSCR(J,K) + 1
      IF(JPART(J).EQ.4)  JTM(J) = JTM(J) + 1
      IF(JPART(J).EQ.5)  JUDEP(J) = JUDEP(J) + 1
 5160 CONTINUE
C
C RETURN
C
      GO TO 95
C
C SUBSECTION 5200
C
C
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 5200 DO 5210 J = 1,JJ
      IF(JPART(J).EQ.0)  GO TO 5210
      SCLE = FLOAT(JSCL(J))
      TTF=ALOC(J)+(SCLE-ALOC(J))*(-ALOG(UNIFN1(SEED)))**(1./SHP(J))
      JTTF(J)=IFIX(TTF)
      JTTL(J)=IFIX(FLOAT(MOT(J))*TEST/R(J))
 5210 CONTINUE
C
C RETURN
C
      GO TO 97
C
C SUBSECTION 7000
C
C CALCULATE PARTS LEVEL TOTALS
C
 5300 JUSET=0;JTOLRT=0;JUDEPT=0;JTMT=0;JSCRT=0;JTOTRT=0
      DO 5310  M = 1,MM
      MJUSET(M)=0;MJTOLRT(M)=0;MJUDEPT(M)=0
      MJTMT(M)=0;MJSCRT(M)=0;MJTOTRT(M)=0
 5310 CONTINUE
C
      DO 5320 J= 1,JJ
      JTOTR(J) = JUSE(J) + JTOLR(J) + JUDEP(J) + JTM(J) + JSCR(J)
 5320 CONTINUE
C
      DO 5330 M = 1,MM
      DO 5340 J =  JF(M),JF(M+1)-1
      MJUSET(M) = MJUSET(M) + JUSE(J)
      MJTOLRT(M) = MJTOLRT(M) + JTOLR(J)
      MJUDEPT(M) = MJUDEPT(M) + JUDEP(J)
      MJTMT(M) = MJTMT(M) + JTM(J)
      MJSCRT(M) = MJSCRT(M) + JSCR(J)
      MJTOTRT(M) = MJTOTRT(M) + JTOTR(J)
 5340 CONTINUE
 5330 CONTINUE
C
      DO 5350 M = 1,MM
      JUSET = JUSET + MJUSET(M)
      JTOLRT = JTOLRT + MJTOLRT(M)
      JUDEPT = JUDEPT + MJUDEPT(M)
      JTMT = JTMT + MJTMT(M)
      JSCRT = JSCRT + MJSCRT(M)
      JTOTRT = JTOTRT + MJTOTRT(M)
 5350 CONTINUE
C
C CALCULATE MODULE REMOVAL TOTALS
C
      MUSET=0;MUDT=0;MTMT=0
      MSCRT=0;MTOTRT=0;MMTUSE2=0;MMTTM2=0
      MRTST=0;MUNRTST=0;MUSNRTST=0;MSCHNRTT=0
      MSCRNRTT=0;MTNRTST=0;MRUNRTS2=0;MNUSPRTT=0
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```
      MXSCHNTT=0;MXSCRNTT=0;MXOKNRTT=0;MNRWTHTL=0
C
 5360 DO 5370 M = 1,MN
      MTOTR(M)=0
      MTOTR(M) = MUSE(M)+MUD(M)+MTM(M)+MSCR(M)
 5370 CONTINUE
C
      DO 5380 M = 1,MN
      MUSET = MUSET + MUSE(M)
      MAUSE(M)=MAUSE(M)+MUSE(M)
      MUDT = MUDT + MUD(M)
      MAUD(M)=MAUD(M)+MUD(M)
      MTMT = MTMT + MTM(M)
      MATM(M)=MATM(M)+MTM(M)
      MSCRT = MSCRT + MSCR(M)
      MASCR(M)=MASCR(M)+MSCR(M)
      MTOTRT = MTOTRT + MTOTR(M)
      MRTST = MRTST + MRTS(M)
      MUNRTST = MUNRTST + MUNRTS(M)
      MUSNRTST = MUSNRTST + MUSNRTS(M)
      MSCHNRTT = MSCHNRTT + MSCHNRTS(M)
      MSCRNRTT = MSCRNRTT + MSCRNRTS(M)
      MXUNRTST = MXUNRTST + MXUNRTS(M)
      MXUSNRTT = MXUSNRTT + MXUSNRTS(M)
      MXSCHNTT = MXSCHNTT + MXSCHNRT(M)
      MXSCRNTT = MXSCRNTT + MXSCRNRT(M)
      MXOKNRTT = MXOKNRTT + MXOKNRTS(M)
      MNRTSWTH(M) = MXUNRTS(M)+MXUSNRTS(M)+MXSCHNRT(M)+MXSCRNRT(M)
      MNRWTHTL = MNRWTHTL + MNRTSWTH(M)
 5380 CONTINUE
C
C CALCULATE (M,K) LINE TOTALS
C
 5430 DO 5440 K = 1,KLAST
      DO 5450 M = 1,MM
      MODTOTR(M,K) = MODUSE1(M,K)+MODUSE2(M,K)+MODTM2(M,K)+MODTM1(M,
     &K)+
     &MODSCR(M,K)
 5450 CONTINUE
 5440 CONTINUE
C
C CALCULATE (M,K) M TOTALS
C
 5460 DO 5470 M = 1,MN
      MTUSE1(M)=0;MTUSE2(M)=0;MTTM2(M)=0;MTTM1(M)=0
      MTTOTR(M)=0;MTSCR(M)=0
      DO 5480 K = 1,KLAST
      MTUSE1(M) = MTUSE1(M) + MODUSE1(M,K)
      MTUSE2(M) = MTUSE2(M) + MODUSE2(M,K)
      MTTM2(M) = MTTM2(M) +MODTM2(M,K)
      MTTM1(M) = MTTM1(M) + MODTM1(M,K)
      MTTOTR(M) = MTTOTR(M) + MODTOTR(M,K)
```

```
          MTSCR(M) = MTSCR(M) + MODSCR(M,K)
 5480 CONTINUE
 5470 CONTINUE
C  COMPUTE TOTAL NRTS BY MODULE
 5540 DO 5550 M = 1,MM
          MTNRTS(M)=MUNRTS(M)+MNONRTS(M)+MSCNNRTS(M)+MSCRNRTS(M)
          MTNRTST = MTNRTST + MTNRTS(M)
 5550 CONTINUE
C
C COMPUTE FINAL REM/1000FH BY MODULE (ABOVE ONLY=FRKFH(M))
C     DEPOT ONLY=FRKFHD(M))   TOTAL FOR CAUSE=FRKFHC(M)
C
 5490 DO 5500 M = 1,MM
          FRKFH(M) = (1000.0*FLOAT(MRTS(M)+MTNRTS(M)))/FLOAT(ISIMPRD)
          FKFH(M)=FKFH(M)+FRKFH(M)
          FRKFHD(M)=(1000.0*FLOAT(MNRTSWTH(M)))/FLOAT(ISIMPRD)
          FRKFHC(M)=FRKFH(M)+FRKFHD(M)
 5500 CONTINUE
C
C CALCULATE FINAL NRTS% BY MODULE
C  BASE LEVEL NRTS%=FNRTSPC(M); DEPOT LEVEL REMOVAL %=DEPPC(M)
C  TOTAL REMOVALS FOR CAUSE, REPAIRED AT DEPOT%=TOTPC(M)
C
          DO 5510 M = 1,MM
          IF(FLOAT(MRTS(M)+MTNRTS(M)).EQ.0.0) GOTO 5510
          FNRTSPC(M) = (100.0*FLOAT(MTNRTS(M)))/FLOAT(MRTS(M)+MTNRTS(M))
          FNRTS(M)=FNRTS(M)+FNRTSPC(M)
          DEPPC(M) = 100.00
          TOP = MTNRTS(M) + MNRTSWTH(M)
          BOTTOM = TOP + FLOAT(MRTS(M))
          TOTPC(M) = 100.0*TOP/BOTTOM
 5510 CONTINUE
C
C COMPUTE ENGINE NRTS%
C
 5520 ENRTSPC = 100.0*FLOAT(NENGNRTS)/FLOAT(NENGTOT)
          ENRTSPCT=ENRTSPCT+ENRTSPC
          IF(ISMAX.EQ.ISDRUN) ENRTS=ENRTSPCT/FLOAT(ISMAX)
C
C COMPUTE ENGINE REM/1000FH
C
 5530 ERKFH = 1000.0*FLOAT(NENGTOT)/FLOAT(ISIMPRD)
          ERKFHT=ERKFHT+ERKFH
          IF(ISMAX.EQ.ISDRUN) EAFH=ERKFHT/FLOAT(ISMAX)
C
C COMPUTE ENGINE REMOVAL LINE TOTALS FOR EACH K PERIOD
C
          DO 5560 K = 1,KLAST
          NGTOTR(K)=NGUSE1(K)+NGUSE2(K)+NGTR2(K)+NGTR3(K)
 5560 CONTINUE
C
C COMPUTE ENGINE REMOVAL COLUMN TOTALS OVER ALL K PERIODS
```

```
C
 5570 NGUSE1T=0;NGUSE2T=0;NGTM2T=0;NGTM1T=0;NGTOTRT=0
C
      DO 5580 K = 1,KLAST
      NGUSE1T = NGUSE1T + NGUSE1(K)
      NGT2(K)=NGT2(K)+NGTM2(K)
      NGU1(K)=NGU1(K)+NGUSE1(K)
      NGU2(K)=NGU2(K)+NGUSE2(K)
      NGT1(K)=NGT1(K)+NGTM1(K)
      NGUSE2T = NGUSE2T + NGUSE2(K)
      NGTM2T = NGTM2T + NGTM2(K)
      NGTM1T = NGTM1T + NGTM1(K)
      NGTOTRT = NGTOTRT + NGTOTR(K)
 5580 CONTINUE
      IOBFMAX=IOBFMAX+NGTOTRT
C
C RETURN
C
      GO TO 105
C
C SUBSECTION 5600
C
C OUTPUT ROUTINES -- REMOVALS TABLES
C
C  ACTUARIAL INPUT TABLE (PAGE 1 OF LONG OR SHORT FORM)
C
 5600 IF (ISDRUN.GT.1) GO TO 5700
C  OUTPUT  --  ACTUARIAL INPUT FACTORS
C
 8300 IPG = IPG+1
      PRINT 8310,INDATA,IPG
 8310 FORMAT("1",T2,A11,9X,"ACTUARIAL INPUT",
     &" FACTORS",15X,"PAGE ",I4)
      PRINT 8315,ENGINE
 8315 FORMAT("0",T30,"ENGINE ",A15)
      PRINT 8316,IDATE,ITIME,LTIME
 8316 FORMAT(1H0,"DATE ",A10,T52,"TIME ",F5.2," SEC ",I2)
      PRINT 8320,NDPIPE,NBPIPE,NSLP
 8320 FORMAT("0","DEPOT PIPE IS",1X,I3,2X,"BASE PIPE IS",I2,2X,
     &"LIST PRICE IS ",I7)
      PRINT 8330,NDPCST,NBSCST
 8330 FORMAT(" ","DEPOT MAINT COST IS",2X,I8,2X,
     &"BASE MAINT COST IS",3X,I5,//)
      DO 8420 M = 1,MM
      PRINT 8430,MODULE(M)
 8430 FORMAT("0",T37,A14)
      PRINT 8400,MDPIPE(M),MBPIPE(M),MSLP(M)
 8400 FORMAT("0","DEPOT PIPE IS",1X,I3,2X,"BASE PIPE IS",I2,
     &2X,"LIST PRICE IS ",I7)
      PRINT 8405,MDPCST(M),MBSCST(M)
 8405 FORMAT(" ","DEPOT MAINT COST IS",2X,I8,
     &2X,"BASE MAINT COST IS",3X,I5)
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      PRINT 8410,MTRCST(M),MOSEPMH(M)
 8410 FORMAT(" ","TRANSPORT COST ",I8.5X,
     &"MANHOUR DATA ",I8)
      PRINT 8415,BRKFH(M),SHP(ISP(M))
 8415 FORMAT(" ","INITIAL REM/1000FH ",F7.4,6X,"DUMMY SHADE IS ",F6
     &.3)
      PRINT 8440
 8440 FORMAT("0","PART  PART",10X,
     &"CONVERT MAX,  BASE  DEPOT  SCALE    UNIT")
      PRINT 8450
 8450 FORMAT(" "," NO.  NAME",1X,
     &"RATIO  TIME SCREEN SCREEN REMAN      PRICE",/)
      DO 8460 J = JF(M),JF(M+1)-1
      PRINT 8470,J,PART(J),R(J),FACT*FLOAT(MOT(J)),
     &JBSESCRN(J),JDPTSCRN(J),JSCL(J),JSLP(J)
 8470 FORMAT(" ",I3,2X,A10,1X,F6.3,1X,
     &F6.0,1X,I5,1X,I5,1X,I5,1X,I8)
 8460 CONTINUE
 8420 CONTINUE
C
C  ENGINE REMOVALS, REPORT PERIOD,K, SUMMARY
C
C  PAGE 2 OF LONG OR SHORT FORM & PAGE 1 OF AVERAGES
C
 5700 IF(IAVG.EQ.1) GO TO 5765
      PRINT 5702
 5702 FORMAT("1",//)
C
 5705 IPG = IPG+1
      PRINT 5710,IPG
 5710 FORMAT("0",T29,"ENGINE REMOVALS",10X,"PAGE ",I3)
      PRINT 5715
 5715 FORMAT (1H0,T26,"REPORT PERIOD SUMMARY")
      PRINT 5720
 5720 FORMAT(1H0,T29,"F100PW100 (F15)")
      PRINT 5725
 5725 FORMAT(1H ,T28,17("-"))
      PRINT 5727,XDATE,FTIME,LTIME
 5727 FORMAT(1H ,"DATE ",A8,T52,"TIME ",F5.2," SEC ",I2)
      PRINT 5730,ISDRUN
 5730 FORMAT(1H0,"SEED RUN",I12,40X,"INPUT    OUTPUT")
      PRINT 5740,BERKFH,EBKFH
 5740 FORMAT(1H ,T40,"REM/1000FH",2F9.4)
      PRINT 5750,ISIMPRD,BENRTSPC,ENRTSPC
 5750 FORMAT(1H ,"SIMULATION PERIOD IS",I7,T42,"UNITS X",3X,F6.2,3X,
     &F6.2)
      PRINT 5760,IRPTPRD
 5760 FORMAT(1H ,"REPORT PERIOD IS",5X,I7)
      PRINT 5770,LFCYC
 5770 FORMAT(1H ,"LIFE PERIOD FOR OBJECTIVE FUNCTION IS ",I3," YEAR
     &S")
      PRINT 5780,MONUTR
```

```
      5780 FORMAT(1H ,"MONTHLY UTILIZATION RATE IS ",I5," FLYING HOURS")
           PRINT 5790,WARMUP
      5790 FORMAT(1H ,"WARMUP?   ",X3)
           PRINT 5800,SDTYP
      5800 FORMAT(1H ,"SEED IS ",A8)
           PRINT 5810,MN,MRULE
      5810 FORMAT(1H ,"NUMBER OF MODULES ",I2,8X,"RULE OF X WAS ",I2//)
           PRINT 5820
      5820 FORMAT(1H ,T22,"ENGINE REMOVALS")
           PRINT 5830
      5830 FORMAT(1H ,T11,39("*"))
           PRINT 5840
      5840 FORMAT(1H ,T12,"* * USAGE * * *   ... TIME ...")
           PRINT 5850
      5850 FORMAT(1H ," REPORT     ONE MOD.  MANY     MANY     ONE")
           PRINT 5860
      5860 FORMAT(1H ," PERIOD     FAILS     MODS.    MODS.    MOT")
           PRINT 5870
      5870 FORMAT(1H ," K  HOURS  EARLY     EARLY    U*T   REACHED   TOTAL
          &")
           PRINT 5875
      5875 FORMAT(1H ,3("-"),1X,8("-"),1X,8("-"),2X,5("-"),2X,5("-"),
          &2X,7("-"),8X,5("-")//)
      5880 FORMAT(1H ,I2,1X,I6,1X,I4,5X,I4,4X,I4,3X,I4,5X,I5)
     C
     C PRINT DATA LINES
     C
           DO 5890 K = 1,KLAST
           PRINT 5880,K,K*IRPTPRD,NOUSE1(K),NGUSE2(K),NGTM2(K),NGTM1(K),
          & NGTOTR(K)
      5890 CONTINUE
     C
     C PRINT TOTALS
     C
           PRINT 5905
      5905 FORMAT(1H ,11X,4("-"),5X,4("-"),4X,4("-"),
          &2(4X,4("-")))
           PRINT 5910,NGUSE1T,NGUSE2T,NGTM2T,NGTM1T,NGTOTRT
      5910 FORMAT (1H ,"TOTALS",3X,I5,4X,I5,3X,I5,2X,I5,4X,I6,///)
     C
           IF(IAVG.EQ.0) GO TO 5920
     C
           PRINT 5915,IOBFMAX
      5915 FORMAT("0","SEED TOTAL ",I9)
           GO TO 9993
     C
     C ENGINE NRTS ANALYSIS. NRTS ALONE
     C
     C  TOP OF PAGE 3 OF LONG OR SHORT FORM NOT AVERAGED
     C
     C HEADING
      5920 IPG = IPG+1
```

```
 5925 PRINT 5930,IPG
 5930 FORMAT(1H1,T27,"ENGINE NRTS ANALYSIS",15X,"PAGE ",I4)
      PRINT 5940
 5940 FORMAT(1H0,T21,"DISTRIBUTION OF MODULE REMOVALS")
      PRINT 5950
 5950 FORMAT(1H0,T23,"(NRTS RETURN TO DEPOT ALONE)")
      PRINT 5960
 5960 FORMAT(1H0,6X,"BASE INITIAL USAGE U-SCREEN SCHED S",
     &"CREEN TOTAL FINAL RRTS  RRMY ")
      PRINT 5970
 5970 FORMAT(1H ,"ITEM   RTS  NRTSX  NRTS    ",6("NRTS    "),
     &" % ALONE  1000EH")
      PRINT 5980
 5980 FORMAT(1H ,"----  ----",1X,7("-"),1X,5("-"),1X,8("-"),1X,
     &5("-"),1X,6("-"),1X,5("-"),1X,10("-"),2X,6("-"),///)
C
C OUTPUT LINES
C
 5990 DO 6000 M = 1,MN
      PRINT 6010,MODABBR(M),NRTS(M),BNRTSPC(M),NUNRTS(M),NUSNRTS(M)
     &,
     &MSCHNRTS(M),MSCRNRTS(M),MTNRTS(M),FNRTSPC(M),RRKFH(M)
 6000 CONTINUE
 6010 FORMAT(1H ,1X,A4,1X,I4,1X,F6.2,2X,I4,4X,I8,3X,I4,
     &3X,I4,4X,I5,3X,F6.2,3X,F8.6)
      PRINT 6012,NRTST,MUNRTST,MUSNRTST,
     &MSCHNRTT,MSCRNRTT,MTNRTST
 6012 FORMAT (1H0,"TOTAL ",I6,9X,I4,4X,I4,3X,I4,
     &3X,I4,4X,I5,///)
C
C ENGINE NRTS ANALYSIS, NRTS WITH ENGINE
C
C  LAST HALF OF PAGE 3 LONG AND SHORT FORM NOT AVERAGED
C
C HEADING
      GO TO 6035
 6030 FORMAT(1H1,T27,"ENGINE NRTS ANALYSIS",10X,"PAGE ",I4)
 6035 PRINT 6038
 6038 FORMAT("0")
      PRINT 6040
 6040 FORMAT(1H0,T21,"DISTRIBUTION OF MODULE REMOVALS")
      PRINT 6050
 6050 FORMAT(1H0,T22,"NRTS WITH ENGINE NRTS PCLECX")
      PRINT 6060
 6060 FORMAT(1H0,T16,"USAGE   U-SCREEN  SCHED  S",
     &"CREEN  TOTAL  NOT AFFECTED")
      PRINT 6070
 6070 FORMAT(1H ,4X,"ITEM",6X,"NRTS",6X,4("NRTS     "),"BUT NRTS")
      PRINT 6080
 6080 FORMAT(1H ,4X,"----",6X,"----",3X,8("-"),2X,"-----  --",
     &"----- ",1X,"------",2X,12("-"),///)
C
```

```
C OUTPUT LINES
C
 6090 DO 6100 M = 1,MN
      PRINT 6110,MODABBR(M),MXUNRTS(M),MXUSNRTS(M),MXSCHNRT(M),
     &MXSCRNRT(M),MNRTSWTE(M),MXOKSRTS(M)
 6100 CONTINUE
 6110 FORMAT(1H ,5X,A4,5X,I4,5X,I4,4X,I4,4X,I4,4X,I4,7X,I4)
      PRINT 6115,MXUNRTST,MXUSNRTT,MXSCHNTT,
     &MXSCRNTT,MNRWTHEL,MXOKNRTT
 6115 FORMAT (1H0,"TOTAL",9X,I4,5X,I4,4X,I4,4X,I4,
     &4X,I4,7X,I4,///)
C
C FOOTNOTES
C
      PRINT 6120,NENGNRTS
 6120 FORMAT(1H0,3X,"TOTAL ENGINE NRTS",10X,I5)
      PRINT 6130,ENRTSPC
 6130 FORMAT(1H ,9X,"ENGINE NRTS %",8X,F6.2)
      PRINT 6140,ERKFH
 6140 FORMAT(1H ,3X,"TOTAL RRM/1000FH",11X,F8.4,///)
      PRINT 6145,NUC,NRX
 6145 FORMAT(" ",3X,"ENGINE USAGE NRTS",I10,"  RULE OF X NRTS",I10)
C
C MODULE REMOVALS BY K PERIOD
C
C  PAGES 4 THRU 11 LONG FORM ELSE NOT PRINTED
C
      IF(IP.EQ.1) GO TO 6800
 6150 DO 6160 M = 1,MN
C HEADING
      IPG = IPG+1
      PRINT 6170,IPG
 6170 FORMAT(1H1,T29,"MODULE REMOVALS",10X,"PAGE ",I4)
      PRINT 6180
 6180 FORMAT(1H ,T26,"REPORT PERIOD SUMMARY")
      PRINT 6190,MODULE(M)
 6190 FORMAT(1H0,T29,A14)
      PRINT 6200
 6200 FORMAT(1H ,T28,15("*"))
      PRINT 6210,ISDRUN
 6210 FORMAT(1H0,"SEED RUN",8X,I2)
      PRINT 6220,MSCRN(M),KPSCRN
 6220 FORMAT(1H ,"SCREEN IS ",I4,"I    TYPE IS   ",A8)
      PRINT 6230,JF(M+1)-JF(M)
 6230 FORMAT(1H ,"NUMBER OF PARTS",3X,I2)
      PRINT 6240,MONUTR
 6240 FORMAT(1H ,"MONTHLY UTILIZATION RATE IS", I5)
      PRINT 6250,IRPTPRD
 6250 FORMAT(1H ,"REPORT PERIOD IS ",I7)
C
C
 6260 PRINT 6270
```

AD-A077 477 AIR FORCE LOGISTICS COMMAND WRIGHT-PATTERSON AFB OH D--ETC F/G 21/5
OPPORTUNISTIC MAINTENANCE ENGINE SIMULATION OMENS III.(U)
OCT 79 J L MADDEN , V L WILLIAMSON
UNCLASSIFIED AFLC/XRS-79-295 NL

2 OF 2
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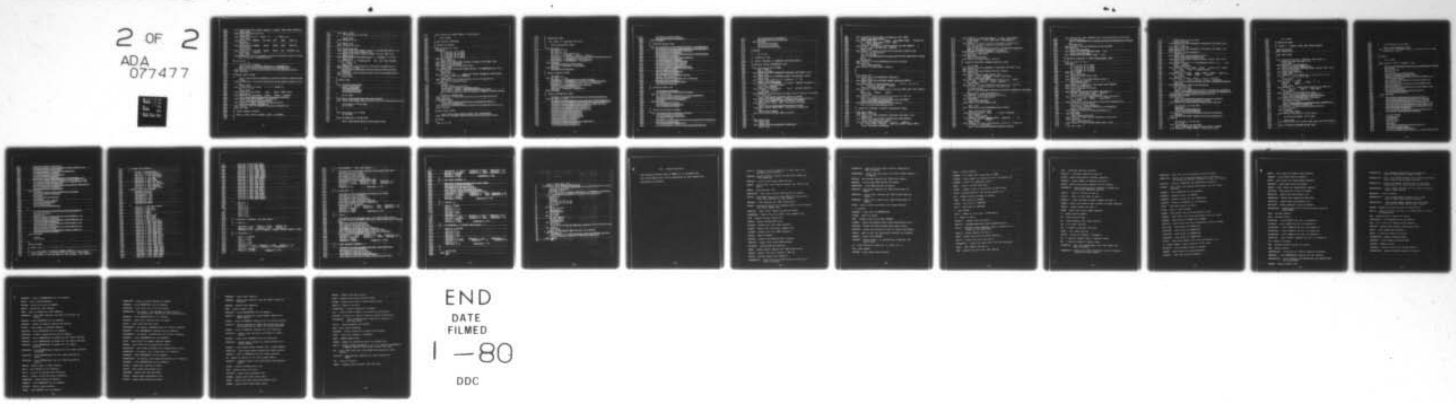

END
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```
      6270 FORMAT(1H0,T15,"MODULE REMOVALS (ALONE + NETS WITH ENGINE)")
           PRINT 6280
      6280 FORMAT(1H ,T11,49("*"))
           PRINT 6290
      6290 FORMAT(1H ,T11,"* * USAGE * * *     ... TIME ...")
           PRINT 6300
      6300 FORMAT(1H ," REPORT    ONE PART  MANY     MANY     ONE",7X,
          &"PARTS")
           PRINT 6310
      6310 FORMAT(1H ," PERIOD     FAILS     PARTS    PETS     NOT",5X,
          &"SCREENED")
           PRINT 6320
      6320 FORMAT(1H ," K HOURS    EARLY     EARLY    UST    REACHED",6X,
          &"OUT",1X,"   TOTAL")
           PRINT 6325
      6325 FORMAT(1H ,2("-"),1X,6("-"),1X,8("-"),1X,7("-"),1X,6("-"),1X,
          &8("-"),2X,8("-"),2X,5("-"),//)
     C
     C LINE PRINT
     C
           DO 6330 K = 1,KLAST
           PRINT 6340,K,K*IRPTPRD,MODUSE1(M,K),MODUSE2(M,K),
          &MODTM2(M,K),MODTM1(M,K),MODSCR(M,K),MODTOTR(M,K)
      6340 FORMAT(1H ,I2,1X,I6,1X,I5,4X,I5,2X,I5,3X,I5,4X,I5,4X,I5)
      6330 CONTINUE
     C
     C TOTALS COMP & PRINT
     C
           PRINT 6350,MTUSE1(M),MTUSE2(M),MTTM2(M),MTTM1(M),MTSCR(M),MTT
          &OTR(M)
      6350 FORMAT(1H0," TOTALS",T12,I5,4X,I5,2X,I5,3X,I5,4X,I5,4X,I5,///
          &)
           PRINT 6355
      6355 FORMAT(1H0,T16,"INPUT     * * * * * FINAL ",
          &"* * * * * *")
           PRINT 6360
      6360 FORMAT(" ",T17,"BASE       BASE     DEPOT   TOTAL POR")
           PRINT 6370
      6370 FORMAT(" ",T16,"LEVEL      LEVEL     LEVEL     CAUSE")
           PRINT 6380,BRKFH(M),FRKFH(M),FRKFHD(M),FRKFHC(M)
      6380 FORMAT(1H0,"REM/1000EFH ",4(1X,F8.4))
           PRINT 6390,BNRTSPC(M),FNRTSPC(M)
      6390 FORMAT(" ","NRTS PERCENT",4X,F6.2,3X,F6.2)
           PRINT 6395,DEPPC(M),TOTPC(M)
      6395 FORMAT(" ","% DEP REPAIR",19X,F6.2,3X,F6.2,////)
      6160 CONTINUE
     C
     C  MODULE REMOVAL SUMMARY
     C
     C  PAGE 12 LONG + PAGE 4 SHORT - PAGE 2 AVERAGED
     C
     C
```

```
      6400 IPG = IPG+1
           IF(IAVG.EQ.2) GO TO 6408
     C
           PRINT 6405
      6405 FORMAT("1",//)
     C
      6408 PRINT 6410
      6410 FORMAT("0",/////)
     C
      6415 PRINT 6420,IPG
      6420 FORMAT(1H0,T38,"MODULE REMOVELS SUMMARY",8X,"PAGE ",I4)
           PRINT 6425,XDATE,FTIME,LTIME
      6425 FORMAT(1H0,"DATE ",A8,T41,"TIME ",F5.2," SEC ",I2)
           PRINT 6430
      6430 FORMAT(1H0,T7,"MODULE",T20,"* * * PRIMARY * * * *")
           PRINT 6440
      6440 FORMAT(1H ," M NOMENCLATURE   USE U-DEP TEMS SCREEN",
          &"   TOTAL  ")
           PRINT 6450
      6450 FORMAT(1H ,"--",1X,14("-"),1X,21("-"),3X,5("-"),//)
      6455 DO 6460 M = 1,MN
           PRINT 6470,M,MODULE(M),MUSE(M),MUD(M),MTM(M),MSCR(M),
          &MTOTR(M)
      6470 FORMAT(1H ,I2,1X,A10,I8,1X,I4,2X,I4,2X,I4,4X,I5,3X,I7)
      6460 CONTINUE
           GO TO 6478
     C
     C TOTALS LINE
     C
     C
      6475 MAUSET=MAUSET+MUSET
           MAUDT =MAUDT+MUDT
           MATMT=MATMT+MTMT
           MASCRT=MASCRT+MSCRT
           MXTOT=MXTOT+MTOTRT
     C
           GO TO 6485
     C
      6478 PRINT 6480,MUSET,MUDT,MTMT,MSCRT,MTOTRT
      6480 FORMAT(1H0,"GRAND TOTAL",T19,I4,1X,I4,2X,I4,2X,I4,4X,I5,//)
     C
           IF(IAVS.GT.1) GO TO 6490
           GO TO 6475
     C
     C
     C
      6485 IF(IP.EQ.1) GO TO 6575
           GO TO 6500
     C
      6490 IF(ISMAX.EQ.1) GO TO 9998
     C
           PRINT 6495,MAUSET,MAUDT,MATMT,MASCRT,MXTOT
```

```
      6495 FORMAT("0","SEED TOTALS ",I7,4(2X,I6))
C
           GO TO 9993
C
C PART REMOVAL SUMMARIES
C
C SUMMARY BY MODULE
C
      6500 DO 6510 M = 1,MM
C HEADINGS
           IF (M.EQ.01) GO TO 6505
           IF (M.LT.04) GO TO 6515
           IF (M.EQ.05) GO TO 6515
           IF (M.GT.06) GO TO 6515
      6505 IPG = IPG+1
           PRINT 6508,IPG
      6508 FORMAT(1H1,T25,"PARTS REMOVAL SUMMARY",15X,"PAGE ",I4)
      6515 PRINT 6520,MODULE(M)
      6520 FORMAT(1H0,2X,14X,9X,">>>",A15)
           PRINT 6530
      6530 FORMAT(1H0,"PART",5X,"PART",8X,8("* "),"REMOVALS",7("* "),
          &3X,"BASE")
           PRINT 6540
      6540 FORMAT(1H ,"NO. J       NAME",8X,"USAGE TOLERANCE U-DEP TIME",
          &" SCREEN TOTAL",3X,"SCREEN")
           PRINT 6550
      6550 FORMAT(1H ,"------",1X,14("-"),(" -----"),4X,9("-"),
          &4(" -----"),2X,8("-"),//)
C LINE PRINT
           ISSCRN = 0
           DO 6560 J=JF(M),JF(M+1)-1
           IF(KPI.EQ.0) ISSCRN = JPRTSCRN(JF(M))
           IF(KPI.EQ.1) ISSCRN = IFIX(FLOAT(JPMOT(J))*FACT)
           PRINT 6570,J,PART(J),JUSE(J),JTOLR(J),JUDEP(J),JTM(J),JSCR(J)
          &,
          & JTOTR(J),JBSESCRN(J)
      6570 FORMAT(1H ,I3,3X,A15,1X,I4,2X,I6,3X,3(I4,2X),I5,3X,I6)
      6560 CONTINUE
C  SUBTOTAL PRINT
           PRINT 6580,MJUSET(M),MJTOLRT(M),MJUDEPT(M),MJTMT(M),
          & MJSCMT(M),MJTOTRT(M)
      6580 FORMAT(1H0,"MODULE TOTALS",T23,I4,2X,I6,3X,3(I4,2X),I5,//)
      6510 CONTINUE
C
C GRAND TOTAL PARTS
C
           PRINT 6590,JUSET,JTOLRT,JUDEPT,JTMT,JSCRT,JTOTRT
      6590 FORMAT(1H0,"GRAND TOTALS",T23,I4,2X,I6,3X,3(I4,2X),I5)
C
C RETURN
C
      6595 GO TO 106
```

```
C
C   SUBSECTION 7500
C
C     PRE OUTPUT -- OBJECTIVE FUNCTION
C
C        PARTS REPLACEMENT COSTS
C
 7300 NGTLCPCS = 0
      DO 7305 M = 1,MM
      MGTLCPCS(M) = 0
      DO 7310 J = JP(M),JP(M+1)-1
      JTPSCHD(J) = JUDEP(J) + JTM(J) + JSCR(J)
      RLCPSCHD(J) = FLOAT(LPCYC)/FLOAT(ISIMYRS)*FLOAT(JTPSCHD(J))
      JTLCPCST(J) = RLCPSCHD(J)*FLOAT(JSLP(J))
      MGTLCPCS(M) = MGTLCPCS(M) + JTLCPCST(J)
 7310 CONTINUE
      MXGPCS(M)=MXGPCS(M)+MGTLCPCS(M)
      NGTLCPCS = NGTLCPCS + MGTLCPCS(M)
 7305 CONTINUE
      NXPCST=NXPCST+NGTLCPCS
C
C  MODULE PIPELINE COSTS
C
      MTPIPCST = 0
 7320 DO 7330 M = 1,MM
      DLCMDDR(M) = FLOAT(MONUTR)/DCONVR*FRKPH(M)
      PIPEQTYM(M) = DLCMDDR(M)*(1.0/100.0)*(FNRTSPC(M)*FLOA
     &T(MDPIPE(M))+(100.0-FNRTSPC(M))*FLOAT(MBPIPE(M)))
      MPIPCST(M) = PIPEQTYM(M)*FLOAT(MSLP(M))
      MXPIP(M)=MXPIP(M)+MPIPCST(M)
      MTPIPCST = MTPIPCST + MPIPCST(M)
 7330 CONTINUE
C
C  MODULE MAINTENANCE COSTS
C
      LCTMCST= 0;LCTMCST1=0;LCTMCST3=0;LCTMCST4=0;LCTMCST2=0
 7340 DO 7350 M = 1,MM
      FACNRTSW(M)=FLOAT(LPCYC)/FLOAT(ISIMYRS)*FLOAT(MNRTSWTM(M))
      FACMNRTS(M)=FLOAT(LPCYC)/FLOAT(ISIMYRS)*FLOAT(MTNRTS(M))
      FACMRTS(M)=FLOAT(LPCYC)/FLOAT(ISIMYRS)*FLOAT(MRTS(M))
      LCMCST1(M)=FACMNRTS(M)*FLOAT(MDPCST(M))
      LCMCST2(M)=FACMRTS(M)*FLOAT(MBSCST(M))
      LCMCST3(M)=FACNRTSW(M)*FLOAT(MDPCST(M))
      LXCST3(M)=LXCST3(M)+LCMCST3(M)
      LXCST2(M)=LXCST2(M)+LCMCST2(M)
      LXCST1(M)=LXCST1(M)+LCMCST1(M)
      LCMCST(M)=LCMCST1(M)+LCMCST2(M)
      LXCST(M)=LXCST(M)+LCMCST(M)
      LCTMCST=LCTMCST+LCMCST(M)
      LCST4(M)=LCMCST1(M)+LCMCST3(M)+LCMCST2(M)
      LCTMCST1=LCTMCST1+LCMCST1(M)
      LCTMCST3=LCTMCST3+LCMCST3(M)
```

```
      LCTMCST4=LCTMCST4+LCST4(M)
      LCTMCST2=LCTMCST2+LCMCST2(M)
 7350 CONTINUE
C
C  COMPLETE ENGINE COSTS
C
 7360 ELCNRTS=FLOAT(LFCYC)/FLOAT(ISIMYRS)*FLOAT(NENGNRTS)
      ELTOTRT=FLOAT(LFCYC)/FLOAT(ISIMYRS)*FLOAT(NGTOTRT)
      NLCDPCST=IFIX(ELCNRTS*FLOAT(NDPCST))
      NENGBASE=NGTOTRT-NENGNRTS
      ELCBASE=FLOAT(LFCYC)/FLOAT(ISIMYRS)*FLOAT(NENGBASE)
      NXDEPO=NXDEPO+NLCDPCST
      NLNBSCST=IFIX(ELCBASE*FLOAT(NBSCST))
      NAVBCST=NBSEPCST/NENGBASE
      LNAVBCST=NBSEPCST*LFCYC/ISIMYRS
      NLCBSCST=LCTECST*LFCYC/ISIMYRS
      NLCRNTST=IFIX(ELTOTRT)*NBSCST
      LCTECST=NLCRNTST+LNAVBCST+NLCDPCST
      NRRCST=LCTECST/NGTOTRT*ISIMYRS/LFCYC
      LXECST=LXECST+LCTECST
      NTCBSCST=NLCRNTST+LNAVBCST
      NXBASE=NXBASE+NTCBSCST
      ELCDDR=ERKFH*FLOAT(MONUTR)/DCONVR
      ERTSPC=100.0-ENRTSPC
      EPIPEQTY=ELCDDR*((ENRTSPC/100.0)*NDPIPE+
     &(ERTSPC/100.0)*NBPIPE)
      NTPIPCST=EPIPEQTY*FLOAT(NSLP)
      NXPIP=NXPIP+NTPIPCST
C
C  TRANSPORTATION COST
C
      LCMTTRAN=0;LCGTTRAN=0
      LCNTRANS=IFIX(ELCNRTS*FLOAT(NTRCST))
 7365 DO 7368 M=1,MM
      LCMTRANS(M)=IFIX(FACNNRTS(M)*FLOAT(MTRCST(M)))
      MXTRCST(M)=MXTRCST(M)+LCMTRANS(M)
      LCMTTRAN=LCMTTRAN+LCMTRANS(M)
 7368 CONTINUE
      NXTRAN=NXTRAN+LCNTRANS
      LCGTTRAN=LCNTRANS+LCMTTRAN
      MXTRAN=MXTRAN+LCGTTRAN
C
C  OBJECTIVE FUNCTION SUMMARY
C
 7370 NOBFNCST=LCTECST+NTPIPCST+LCNTRANS
      IOBFNTOT=0;ILCMCST=LCTECST
      IMPIPCST=NTPIPCST;INGTLCPC=0
      DO 7380 M = 1,MM
      MOBFNCST(M)=LCMCST1(M)+MPIPCST(M)+MGTLCPCS(M)+LCMCST3(M)+
     &LCMCST2(M)+LCMTRANS(M)
      IOBFNTOT=IOBFNTOT+MOBFNCST(M)
      ILCMCST=ILCMCST+LCMCST1(M)+LCMCST3(M)+LCMCST2(M)
```

```
              IMPIPCST=IMPIPCST+MQIPCST(M)
              IMGTLCPC=IMGTLCPC+MGTLCPCS(M)
        7380 CONTINUE
              IXCST=IXCST+ILCMCST
              IXPIP=IXPIP+IMPIPCST
              IXPART=IXPART+IMGTLCPC
C
C RETURN
C
              GO TO 107
C
C   SUBSECTION 7600
C
C   OUTPUT ROUTINES -- OBJECTIVE FUNCTION TABLES
C
C COMPLETE ENGINE MAINTENANCE COST
C
        7400 IF(IP.EQ.1) GO TO 7400
              IPG = IPG+1
              PRINT 7410,IPG
        7410 FORMAT(1H1,T21,"OBJECTIVE FUNCTION",T53,"PAGE ",I4)
              PRINT 7405
        7405 FORMAT("0",T14,"COMPLETE ENGINE MAINTENANCE COSTS")
              PRINT 7403
        7403 FORMAT("0",/,T29,"* * * * FACTORS * * * *")
              PRINT 7415,LFCYC,LFCYC
        7415 FORMAT("0",T13,"ENGINE     * ",I2,"/  REM/REP AV.BASE ",
            & "AV.DEP. ",1X,I2,"-YEAR")
              PRINT 7420,ISIMYRS
        7420 FORMAT(" ",T13,"REMVLS          ",I3,"  CST/REM CST/REM ",
            &  "CST/REM  COSTS")
              PRINT 7425
        7425 FORMAT(" ",T13,"------ -------- ------- ------- -------",
            &"  -------")
              PRINT 7430,NGTOTRT,ELTOTRT,NBSCST,NLCBRTST
        7430 FORMAT("0","BASE REMVLS ",1X,I4,1X,F8.4,3X,I5,18X,I7)
              PRINT 7435,NENGBASE,ELCBASE,NAVBCST,LNAVBCST
        7435 FORMAT("0"," BASE   RTS   ",I4,1X,F8.4,10X,I6,
            &10X,I7)
              PRINT 7440,NENGNRTS,ELCNRTS,NDPCST,NLCDPCST
        7440 FORMAT("0"," DEPOT RRTS   ",I4,1X,F8.4,10X,I6,3X,
            &I7)
              PRINT 7445,LCTECST
        7445 FORMAT("0",/,"GRAND TOTAL",41X,I8)
C
C
C
        7500 PRINT 7510
        7510 FORMAT("0")
              PRINT 7515
        7515 FORMAT("0",T28,"OBJECTIVE FUNCTION")
              PRINT 7520
```

```
      7520 FORMAT("0",T20,"MODULE MAINTENANCE COST WITH")
           PRINT 7530,LFCYC,LFCYC
      7530 FORMAT("0",2X,"      MODULE    ",3X,"TOTAL NRTS      *",I2,"/",
          &"    DEPOT ",3X,"TOTAL ",I2," YRS")
           PRINT 7540,ISIMYRS
      7540 FORMAT(" ","ITEM",1X,"NOMENCLATURE",3X,"MOD REMOVLS    ",
          &1X,13X," COST FACTOR",3X,"  DEPOT")
           PRINT 7550
      7550 FORMAT(" ","----",1X,18("-"),1X,11("-"),1X,8("-"),4X,
          &11("-"),1X,12("-")///)
           DO 7570 M=1,NM
           PRINT 7580,MODABBR(M),MODULE(M),MNRTSWTH(M),FACNRTSW(M),MNPCS
          &T(M),
          &LCMCST3(M)
      7580 FORMAT(" ",A4,1X,A18,I7,5X,F8.4,2X,I8,4X,I9)
      7570 CONTINUE
           PRINT 7590,LCTMCST3
      7590 FORMAT("0",T48,"TOTAL ",I9///)
     C
     C
     C
     C
      7600 PRINT 7610
      7610 FORMAT(1H0,T28,"OBJECTIVE FUNCTION")
           PRINT 7620
      7620 FORMAT("0",T21,"COMPLETE ENGINE PIPELINE COSTS")
           PRINT 7630
      7630 FORMAT("0",1X,"DAILY DEMAND RATE    N R T S    B A S E",
          &"    PIPELINE STK LIST   TOTAL")
           PRINT 7640,MONUTR,IDCR
      7640 FORMAT(" ","REM/1000FH*",I2,"/",I5,2X,"RATE PIPE RATE PIPE",3
          &X,
          &"QUANTITY     PRICE      COST")
           PRINT 7650
      7650 FORMAT(" ",8("-"),2X,10("-"),1X,2("---- ----"),
          &2X,8("-"),2X,8("-"),1X,7("-"))
           PRINT 7660,ERKFH,ELCDDR,ENRTSPC,NDPIPE,ERTSPC,
          &NBPIPE,EPIPEQTY,NSLP,NTPIPCST
      7660 FORMAT("0",F7.4,2X,F10.7,1X,F5.1,I4,1X,
          &F5.1,1X,I3,3X,F8.5,2X,I8,1X,I7)
     C
     C  OBJECTIVE FUNCTION -- MODULE MAINTENANCE COSTS
     C
      7700 IPG = IPG+1
      7720 PRINT 7730,IPG
      7730 FORMAT("1",T28,"OBJECTIVE FUNCTION",18X,"PAGE ",I4)
           PRINT 7740
      7740 FORMAT("0",T22,"MODULE MAINTENANCE COSTS-ALONE")
           PRINT 7750,LFCYC,LFCYC,LFCYC
      7750 FORMAT("0",5X,"TOTAL NRTS  *",I2,"/     DEPOT",
          &"    TOTAL BASE  *",I2,"/     BASE",8X,"TOTAL ",I2," YRS")
           PRINT 7760,ISIMYRS,ISIMYRS
```

```
      7760 FORMAT(" ","ITEM MOD REMVLS   ",I3,"  COST FACT",
     &" MOD REMVLS   ",I3," COST FACT  DEPOT&BASE")
           PRINT 7770
      7770 FORMAT(" ","---- ",10("-"),1X,6("-"),1X,9("-"),1X,
     &10("-"),1X,5("-"),1X,9("-"),1X,12("-"),//)
           DO 7780 M=1,MM
           PRINT 7790,MODABBR(M),MTMRTS(M),FACMRTS(M),MDPCST(M),
     &MRTS(M),FACMRTS(M),MBSCST(M),LCMCST(M)
      7790 FORMAT(" ",A4,2X,I4,3X,F8.4,1X,I7,3X,I4,
     &3X,F8.4,1X,I6,4X,I8)
      7780 CONTINUE
           PRINT 7795,LCTMCST
      7795 FORMAT("0",T56,"TOTAL ",I9,///)
C
C  OBJECTIVE FUNCTION --MODULE PIPELINE COSTS
C
           GO TO 7825
      7820 FORMAT("1",T28,"OBJECTIVE FUNCTION",13X,"PAGE ",I4)
      7825 PRINT 7830
      7830 FORMAT("0",T26,"MODULE PIPELINE COSTS")
           PRINT 7840
      7840 FORMAT("0",6X,"DAILY DEMAND RATE   ",
     &"NRTS   BASE   PIPELINE  MODULE COST PER")
           PRINT 7850,MONUTR,IDCR
      7850 FORMAT(" ","ITEM REM/1000FH",I2,"/",I5,"  PIPE",
     &"   PIPE   QTY/MOD    PRICE  MODULE")
           PRINT 7860
      7860 FORMAT(" ","----",1X,8("-"),2X,"---------- ",6("-"),
     &" ------ --------- ------- ---------",//)
           DO 7870 M=1,MM
           PRINT 7880,MODABBR(M),PRXFH(M),DLCMDDR(M),MDPIPE(M),MBPIPE(M)
     &,
     &PIPEQTYM(M),MSLP(M),MPIPCST(M)
      7880 FORMAT(" ",A4,1X,F7.4,2X,F10.7,2X,I4,
     &3X,I4,2X,F9.5,1X,I7,1X,I8)
      7870 CONTINUE
           PRINT 7890,MTPIPCST
      7890 FORMAT("0",T53,"TOTAL ",I8)
C
           PRINT 7900
      7900 FORMAT("0",/,T19,"TRANSPORTATION COSTS")
C
           PRINT 7910,LFCYC,LFCYC
      7910 FORMAT("0",T24," NRTS      * ",I2,"/ TRANSPT  "
     &,I2,"-YEAR")
           PRINT 7920,ISIMYRS
      7920 FORMAT(" ","ITEM NOMENCLATURE   REMOVALS  ",
     &I3," CST/REM    COSTS")
           PRINT 7930
      7930 FORMAT(" ","---- ------------- -------- --------",
     &" ------- ---------")
           PRINT 7940,NENGNRTS,ELGNRTS,RTRCST,LCNTRANS
```

```
7940 FORMAT("0"," ENG COMPLETE ENS.",5X,I4,3X,F8.4,1X,I7,2X,I7)
     DO 7950 M=1,MM
     PRINT 7960,MODABBR(M),MODULE(M),MTNRTS(M),FACHNRTS(M),MTRCST(
    &M)
    &,LCMTRANS(M)
7960 FORMAT(" ",A4,1X,A15,3X,I4,3X,F8.4,I8,I9)
7950 CONTINUE
     PRINT 7970,LCMTTRAN
7970 FORMAT("0",T34,"MODULES TOTAL  ",I7)
     PRINT 7980,LCGTTRAN
7980 FORMAT("0",T36,"GRAND TOTAL  ",I7)
C
C OBJECTIVE FUNCTION -- PARTS REPLACEMENT COSTS
C
8000 DO 8010 M = 1,MM
C HEADINGS
     IF (M.EQ.01) GO TO 8005
     IF (M.LT.04) GO TO 8015
     IF (M.EQ.05) GO TO 8015
     IF (M.GT.06) GO TO 8015
8005 IPG = IPG+1
     PRINT 8020,IPG
8020 FORMAT("1",T50,"PAGE ",I4)
     PRINT 8030
8030 FORMAT(" ",T13,"LIFE-LIMITED PARTS ",
    &"REPLACEMENT COSTS")
     PRINT 8040,LFCYC
8040 FORMAT(" ",T20,"FOR ",I2,"-YEAR LIFE CYCLE")
8015 PRINT 8045,MODULE(M)
8045 FORMAT("0",T24,">>>",A15)
     PRINT 8050
8050 FORMAT("0","PART",9X,"PART",6X,"TOTAL ",
    &"SCHED  SCHED RNVL  UNIT    TOTAL")
     PRINT 8060,ISIMYRS,LFCYC,LFCYC
8060 FORMAT(" "," NO.",9X,"NAME",6X,"RNVL(",I3,"YR)",
    &"  (",I2,"YR)   PRICE    ",I2,"-YR")
     PRINT 8065
8065 FORMAT(1H ,4("-"),1X,14("-"),1X,11("-"),2X,10("-"),
    &1X,5("-"),2X,7("-"),//)
     DO 8070 J = JF(M),JF(M+1)-1
     PRINT 8080,J,PART(J),JTPSCHD(J),RLCPSCHD(J),
    &JSLP(J),JTLCPCST(J)
8080 FORMAT(" ",I3,2X,A15,4X,I4,5X,F9.5,1X,
    &I7,1X,I8)
8070 CONTINUE
     PRINT 8090,MGTLCPCS(M)
8090 FORMAT("0",T36,"MODULE SUBTOTAL",1X,I8,//)
8010 CONTINUE
     PRINT 8095,NGTLCPCS
8095 FORMAT("0",T32,"ENGINE GRAND TOTAL ",I9)
C
8100 IPG = IPG + 1
```

```
      IF(IAVG.GT.1) GO TO 8104
      PRINT 8102,IPG
 8102 FORMAT("1",T28,"OBJECTIVE FUNCTION",10X,"PAGE ",I4)
      GO TO 8108
 8104 PRINT 8105,IPG
 8105 FORMAT("0",T28,"OBJECTIVE FUNCTION",10X,"PAGE ",I4)
 8108 PRINT 8110
 8110 FORMAT(" ",T39,"SUMMARY")
      PRINT 8115
 8115 FORMAT("0",T30,"F100PW100(F15)")
      PRINT 8120,XDATE,FTIME,LTIME
 8120 FORMAT("0","DATE ",A8,T53,"TIME ",F5.2," SEC ",I2)
      PRINT 8125
 8125 FORMAT("0",I8,"* * * MAINTENANCE COSTS * * *      P",
     &"IPE    TRANS")
      PRINT 8130,LXCYC
 8130 FORMAT(" ",T8," ALONE      ALONE      WITH",T44," LINE",
     &"     PORT    PARTS  ",1X,I2,"-YEAR")
      PRINT 8135
 8135 FORMAT(" ","ITEM     BASE     DEPOT     DEPOT     TOTALS",
     &"    COSTS     COSTS     COSTS        COSTS")
      PRINT 8140
 8140 FORMAT(" ","----   -------   -------   --------",
     &"  -------  -------   ---------")
      PRINT 8145,NTCBSCST,NLCDPCST,LCTECST,NTPIPCST,LCNTRANS,
     &NOBFNCST
 8145 FORMAT(1H0," ENG",1X,I7,9X,I7,I9,
     &I8,I8,10X,I8,//)
      DO 8150 M = 1,MM
      PRINT 8155,MODABBR(M),LCMCST2(M),LCMCST1(M),LCMCST3(M),
     &LCST4(M),MPIPCST(M),LCMTRANS(M),MGTLCPCS(M),MOBFNCST(M)
 8155 FORMAT(1H ,A6,I8,I8,I8,I9,I8,I8,I8,I10)
C TOTALS FOR MODULES
 8150 CONTINUE
      PRINT 8160,LCTMCST2,LCTMCST1,LCTMCST3,LCTMCST4,
     &MTPIPCST,LCMTTRAN,MGTLCPCS,IOBFNTOT
 8160 FORMAT(1H0,"MODTOT",I6,I8,I8,I9,I8,I8,I8,I10)
C
      IF(IAVG.GT.1) GO TO 8170
      IOBFNGT=0
      IOBFNGT=IOBFNTOT+NOBFNCST
      IAOBGTOT=IAOBGTOT+IOBFNGT
 8170 PRINT 8180,ILCMCST,IMPIPCST,LCGTTRAN,IMGTLCPC,
     &IOBFNGT
 8180 FORMAT(1H0,"GRAND TOTALS",T31,I8,I8,I8,I8,I10)
C RETURN
C
      IF(IAVG.GT.1) GO TO 8190
      GO TO 108
 8190 IF(ISMAX.EQ.1) GO TO 9998
      PRINT 8195,IXCST,IXDIP,MXTRAN,IXPART,IACBGTOT
 8195 FORMAT("0","SEED TOTALS ",4(2X,I9),3X,I10)
```

```
      GO TO 9995
C
C SUBSECTION 8200
C
C  OUTPUT -- SCREEN, NRTS, REM/1000FH SUMMARY
C
 8200 PRINT 8205
 8205 FORMAT("0")
C
 8208 PRINT 8210
C
C
 8210 FORMAT("0",T15,"* ","SCREEN, NRTS RATE & ",
     &"REMOVALS PER 1000 FH"," *")
      PRINT 8220
 8220 FORMAT(" ",T32,"SUMMARY")
      PRINT 8225,XDATE,FTIME,LTIME
 8225 FORMAT(1H0,"DATE ",A8,T52,"TIME ",F5.2," SEC ",I2)
      PRINT 8230,BLKAVG
 8230 FORMAT("0",T29,A19)
      PRINT 8235
 8235 FORMAT(" ",T20,"DEPOT",2X,"* I N I T I A L *",
     &"       * * F I N A L * *")
      PRINT 8240
 8240 FORMAT(" ","  ITEM              ",
     &"SCREEN         NRTS           REM/        ",
     &"NRTS          REM/")
      PRINT 8250
 8250 FORMAT(" ","  NAME",11X,"INTERVAL",3X,"RATE X",
     &"  1000 FH.      RATE %     1000 FH.")
      PRINT 8260
 8260 FORMAT(" ",13("-"),8X,8("-"),3X,
     &6("-"),4X,8("-"),4X,6("-"),4X,8("-"))
      PRINT 8270,BENRTSPC,BERKFH,ENRTSPC,ERKFH
 8270 FORMAT("0","COMPLETE ENG.",15X,F6.2,
     &4X,F8.4,4X,F6.2,4X,F8.4,/)
      DO 8280 M = 1,MN
      PRINT 8290,MODULE(M),JDPTSCRN(JE(M)),BNRTSPC(M),
     &BRKFH(M),FNRTSPC(M),FRKFH(M)
 8290 FORMAT(" ",A14,3X,I5,4X,F6.2,4X,F8.4,4X,
     &F6.2,4X,F8.4)
 8280 CONTINUE
      PRINT 8295,MRULE
 8295 FORMAT(1H0,"RULE OF X WAS ",I2,/)
C
      IF(ISMAX.EQ.ISDRUN) GO TO 8299
C
      PRINT 8298
 8298 FORMAT(1H0,15("*"),10X,"NEXT SEED RUN",10X,15("*"))
C
 8299 IF(ISMAX.NE.ISDRUN) GO TO 1020
C
```

```
C
      IF(IAVG.EQ.0) GO TO 9992
C
      PRINT 8297,ENRTSPCT,ENKFPT
 8297 FORMAT("0",T15,"SEED TOTALS ",2X,"NRTS % ",F6.2,2X,
     &"REMOVALS ",F8.4)
C
C
C RETURN
C
      GO TO 9998
C
 8600 BLKAVG = ">>> * AVERAGE * <<<"
C
      MUSET=0$MUDT=0$MTMT=0$MTOTRT=0$MSCRT=0$ENRTSPC=EANRTS
      ENKFH=EAFH
      DO 8605 M=1,NM
      MTOTR(M)=0
      FRKFH(M)=FKFH(M)/FLOAT(ISMAX)
      FNRTSPC(M)=FNRTS(M)/FLOAT(ISMAX)
      MUSE(M)=IFIX((FLOAT(MAUSE(M))/FLOAT(ISMAX))+.5)
      MUSET=MUSET+MUSE(M)
      MUD(M)=IFIX((FLOAT(MAUD(M))/FLOAT(ISMAX))+.5)
      MUDT=MUDT+MUD(M)
      MTM(M)=IFIX((FLOAT(MATM(M))/FLOAT(ISMAX))+.5)
      MTMT=MTMT+MTM(M)
      MSCR(M)=IFIX((FLOAT(MASCR(M))/FLOAT(ISMAX))+.5)
      MSCRT=MSCRT+MSCR(M)
      MTOTR(M)=MUSE(M)+MUD(M)+MTM(M)+MSCR(M)
      MTOTRT=MTOTRT+MTOTR(M)
 8605 CONTINUE
C
      IOBFNTOT=0$LCTMCST=0$LCTMCST3=0$LCTECST=0
      NOTLCPCS=0$LCTMCST4=0$LCTMCST2=0$LCMTTRAN=0
      MTPIPCST=0$NOBFNCST=0$LCTMCST1=0$LCGTTRAN=0
      LCNTRANS=IFIX((FLOAT(NXTRAN)/FLOAT(ISMAX))+.5)
      NLCDPCST=IFIX((FLOAT(NXDEPO)/FLOAT(ISMAX))+.5)
      NTCBSCST=IFIX((FLOAT(NXBASE)/FLOAT(ISMAX))+.5)
      LCTECST=NLCDPCST+NTCBSCST
      NTPIPCST=IFIX((FLOAT(NXPIP)/FLOAT(ISMAX))+.5)
      NOBFNCST=LCTECST+NTPIPCST+LCNTRANS
C
      DO 8610 M=1,NM
      LCMTRANS(M)=0
      LCMCST(M)=0
      MOBFNCST(M)=0
      LCST4(M)=0
      DCST3=0.0
      DCST3=FLOAT(LXCST3(M))/FLOAT(ISMAX)+.5
      LCMCST3(M)=IFIX(DCST3)
      LCTMCST3=LCTMCST3+LCMCST3(M)
      LCMCST1(M)=IFIX((FLOAT(LXCST1(M))/FLOAT(ISMAX))+.5)
```

```
      LCTMCST1=LCTMCST1+LCMCST1(M)
      LCMCST2(M)=IFIX((FLOAT(LXCST2(M))/FLOAT(ISMAX))+.5)
      LCTMCST2=LCTMCST2+LCMCST2(M)
      LCST4(M)=LCMCST1(M)+LCMCST3(M)+LCMCST2(M)
      LCTMCST4=LCTMCST4+LCST4(M)
      LCMCST(M)=LCMCST2(M)+LCMCST1(M)
      LCTMCST=LCTMCST+LCMCST(M)
      MPIPCST(M)=IFIX((FLOAT(MXPIP(M))/FLOAT(ISMAX))+.5)
      MGTLCPCS(M)=IFIX((FLOAT(MXGPCS(M))/FLOAT(ISMAX))+.5)
      LCMTRANS(M)=IFIX((FLOAT(MXTRCST(M))/FLOAT(ISMAX))+.5)
      LCMTTRAN=LCMTTRAN+LCMTRANS(M)
      MOBFNCST(M)=LCST4(M)+MPIPCST(M)+MGTLCPCS(M)+LCMTRANS(M)
      MTPIPCST=MTPIPCST+MPIPCST(M)
      MGTLCPCS=MGTLCPCS+MGTLCPCS(M)
 8610 CONTINUE
      IOBFNTOT=LCTMCST4+MTPIPCST+MGTLCPCS+LCMTTRAN
      LCGTTRAN=LCMTTRAN+LCMTRANS
      IOBFNGT=0
      IOBFNGT=IOBFNTOT+MOBFNCST
      ILCMCST=0
      ILCMCST=LCTMCST4+LCTMCST
      IMGTLCPC=0;IMPIPCST=0
      IMGTLCPC=MGTLCPCS
      IMPIPCST=MTPIPCST+MTPIPCST
C
C
      NGTOTRT=0;NGUSE1T=0;NGUSE2T=0;NGTM2T=0;NGTM1T=0
      DO 8615 K=1,KLAST
      NGTOTM(K)=0
      NGUSE1(K)=IFIX((FLOAT(NGU1(K))/FLOAT(ISMAX))+.5)
      NGUSE1T=NGUSE1T+NGUSE1(K)
      NGUSE2(K)=IFIX((FLOAT(NGU2(K))/FLOAT(ISMAX))+.5)
      NGUSE2T=NGUSE2T+NGUSE2(K)
      NGTM2(K)=IFIX((FLOAT(NGT2(K))/FLOAT(ISMAX))+.5)
      NGTM2T=NGTM2T+NGTM2(K)
      NGTM1(K)=IFIX((FLOAT(NGT1(K))/FLOAT(ISMAX))+.5)
      NGTM1T=NGTM1T+NGTM1(K)
      NGTOTM(K)=NGUSE1(K)+NGUSE2(K)+NGTM2(K)+NGTM1(K)
      NGTOTRT=NGTOTRT+NGTOTM(K)
 8615 CONTINUE
C
      IAVG=0
      GO TO 9993
C
C
 9000 CONTINUE
C
C     INPUT DATA * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C     * * * 7.0 F100 * 10 AUG 79 FACTORS REVIEW * * * * * * * * * * * * *
C     PART NUMBERS 301, 302 MOVED FROM FAN TO ACC1 SINCE THESE
C     ARE EXTERNAL TO FAN AND CAUSE NO FAN REMOVAL,  EFF 29JAN79
```

```
      C * NAMES AND INDICES *
      C
            INDATA = "DATA22OCT79"
            ENGINE = "F100PW100(F15)"
            MODULE(1) = "700 AUGMENTOR"
            MODULE(2) = "100 ACC1 WLL"
            MODULE(3) = "300 FAN"
            MODULE(4) = "400 CORE"
            MODULE(5) = "500 H P TURB"
            MODULE(6) = "600 FAN DR TUR"
            MODULE(7) = "800 GEARBOX"
            MODULE(8) = "900 ACC2 WOLL"
      C ABBREVIATED MODULE NAMES
            MODABBR(1)=" AUG"
            MODABBR(2)="ACC1"
            MODABBR(3)=" FAN"
            MODABBR(4)=" COR"
            MODABBR(5)=" HPT"
            MODABBR(6)=" FDT"
            MODABBR(7)=" GBX"
            MODABBR(8)="ACC2"
      C
            PART(1) = "700 AUGM DUMMY"
            PART(2) = "104 UFC"
            PART(3) = "AFPC/FOC"
            PART(4) = "AOC"
            PART(5) = "AEP"
            PART(6) = "RCVV/IAIV"
            PART(7) = "301 VANE"
            PART(8) = "302 VANE"
            PART(9) = "300 FAN DUMMY"
            PART(10) = "303 1STG DISK"
            PART(11) = "304 2STG DISK"
            PART(12) = "305 3STG DISK"
            PART(13) = "306 1STG SEAL"
            PART(14) = "307 FRNT SEAL"
            PART(15) = "308 REAR SEAL"
            PART(16) = "309 RETAINER"
            PART(17) = "310 2STG SEAL"
            PART(18) = "400 CORE DUMMY"
            PART(19) = "401 4STG SEAL"
            PART(20) = "402 5STG SEAL"
            PART(21) = "403 6STG SEAL"
            PART(22) = "404 7STG SEAL"
            PART(23) = "405 8STG SEAL"
            PART(24) = "406  9STG SEAL"
            PART(25) = "407 10STG SEAL"
            PART(26) = "408 11STG SEAL"
            PART(27) = "409 12STG SEAL"
            PART(28) = "410 13STG SEAL"
            PART(29) = "411 4STG DISK"
            PART(30) = "412 5STG DISK"
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      PART(31) ="413 6STG DISK"
      PART(32) = "414 7STG DISK"
      PART(33) = "415 8STG DISK"
      PART(34) = "416 9STG DISK"
      PART(35) = "417 10STG DISK"
      PART(36) = "418 11STG DISK"
      PART(37) = "419 12STG DISK"
      PART(38) = "420 13STG DISK"
      PART(39) = "421 REAR SHAFT"
      PART(40) = "500 HPT DUMMY"
      PART(41) = "501 1STG DISK"
      PART(42) = "502 2STG DISK"
      PART(43) = "503 2STG DISK"
      PART(44) = "504 1STG FPLT"
      PART(45) = "505 1STG RPLT"
      PART(46) = "600 FDT DUMMY"
      PART(47) = "601 3STG DISK"
      PART(48) = "602 4STG DISK"
      PART(49) = "603 4STG DISK"
      PART(50) = "800 GBOX DUMMY"
      PART(51) = "900 ACCS DUMMY"
C
      JF(1) = 1
      JF(2) = 2
      JF(3) = 9
      JF(4) = 18
      JF(5) = 40
      JF(6) = 46
      JF(7) = 50
      JF(8) = 51
      JF(9) = 52
C
C - ACTUARIAL, PIPELINE, AND COST DATA -
C
C - - ENGINE - -
C
      BENRTSPC = 7.0;  NDPCST = 14652;   NDPIPE = 56
      BERKFH = 5.75;    NBSCST = 161;      NBPIPE = 4
      NBTESTMH = 12;  NSLP = 1700000;  NTRCST = 5000; BMNCST = 12.0
C
C - - AUGMENTOR - -
C
      MOT(1) = 1000000
      R(1)   = 1.0
      ALOC(1) = 0.0
      SMP(1)  = 1.0
      JSCL(1) = 974
      BNRTSPC(1) = 9.0;  MDPCST(1) = 2899;   MDPIPE(1) = 41
      BRKFH(1)   = 1.5067; MBSCST(1) = 775;MBPIPE(1) =  4
      MSLP(1) = 860000
      MTRCST(1) = 2066;              MBSRPMH(1) = 30
C
```

```
C - - ACCESSORIES 1  WITH LIFE LIMITS - -
C
      DATA(MOT(I),I=2,8)/2000,1200,3000,3200,3600,1454,1454/
      DATA(R(I),I=2,8)/7*2.6/
      DATA(ALOC(I),I=2,8)/7*0.0/
      DATA(SMP(I),I=2,8)/7*5.0/
      DATA(JSCL(I),I=2,8)/7*990000/
      DATA(JSLP(I),I=2,8)/5*1000,3090,838/
      BNRTSPC(2) = 0.0;     MDPCST(2) = 846;     MDPIPE(2) = 4
      BRKFH(2) = 0.0000;    MBSCST(2) = 846;     MBPIPE(2) = 2
      MSLP(2) = 0
      MTRCST(2) = 0;                MBSEPMH(2) = 28
C
C - - INLET FAN - -
C
      DATA(MOT(I),I=9,17)/2000,3400,3300,3000,5*10000/
      DATA(R(I),I =9,17)/9*2.20/
      DATA(ALOC(I),I=9,17)/9*0.0/
      DATA(SMP(I),I=9,17)/4*6.0,5*5.0/
      DATA(JSCL(I),I=9,17)/4033,8*990000/
      DATA(JSLP(I),I=9,17)/0,7310,6054,3016,
     &1848,1406,1387,744,2048/
      BNRTSPC(3) =    86.0;    MDPCST(3) =  2667;    MDPIPE(3) = 38
      BRKFH(3) = 0.3050;       MBSCST(3)=    839;    MBPIPE(3) =  4
      MSLP(3) = 177000
      MTRCST(3) = 888;                MBSEPMH(3) = 78
C
C - - CORE - -
C
      DATA(MOT(I),I=18,39)/2000,9400,17500,8200,11000,5*5600,
     &2*15000,13000,21000,5500,7500,8300,15500,14000,10500,13500,15
     &500/
      DATA(R(I),I=18,39)/22*2.20/
      DATA(ALOC(I),I=18,39)/22*0.0/
      DATA(SMP(I),I=18,39)/1.0,21*5.0/
      DATA(JSCL(I),I=18,39)/92915,21*990000/
      DATA(JSLP(I),I=18,39)/0,1093,1280,1424,1183,
     &1742,1818,8292,2308,2369,5283,4708,3893,8434,8764,
     &4448,8849,8441,8448,8841,8888,9798/
      BNRTSPC(4) =  78.0;     MDPCST(4) = 5422;    MDPIPE(4) = 48
      BRKFH(4) = 0.6100;      MBSCST(4) =  2800;   MBPIPE(4) =  8
      MSLP(4) = 704000
      MTRCST(4) = 2013;               MBSEPMH(4) = 250
C
C - - HIGH PRESSURE TURBINE - -
C
      DATA(MOT(I),I=40,45)/2000,8100,9800,1800,1800,1800/
      DATA(R(I),I=40,45)/6*2.20/
      DATA(ALOC(I),I=40,45)/6*0.0/
      DATA(SMP(I),I=40,45)/1.0,5*5.0/
      DATA(JSCL(I),I=40,45)/18058,5*990000/
      DATA(JSLP(I),I=40,45)/0,14555,12416,6023,2344,958/
```

```
      BNRTSPC(5) = 34.0;     MDPCST(5) = 1203;   MDPIPE(5) = 24
      BRKFH(5) = 0.9150;     MBSCST(5) = 880;    MDPIPE(5) = 5
      MSLP(5) = 231020
      MTRCST(5) = 433;                  MBSEPMH(5) = 150
C
C * * FAN DRIVE TURBINE * *
C
      DATA(MOT(I),I=46,49)/2800,3300,3000,100000/
      DATA(R(I),I=46,49)/4*2.20/
      DATA(ALOC(I),I=46,49)/4*0.0/
      DATA(SHP(I),I=46,49)/1.0,3*5.0/
      DATA(JSCL(I),I=46,49)/0270,3*990000/
      DATA(JSLP(I),I=46,49)/0.8028,6502,35017/
      BNRTSPC(6) = 36.0;     MDPCST(6) =  1959;  MDPIPE(6) = 29
      BRKFH(6) = 0.3965;     MBSCST(6) =  530;   MDPIPE(6) = 5
      MSLP(6) = 169000
      MTRCST(6) = 1107;                 MBSEPMH(6) = 113
C
C * * GEARBOX * *
C
      MOT(50) = 8000
      R(50) = 1.0
      ALOC(50) =  0.0
      SHP(50) = 1.0
      JSCL(50) = 5944
      JSLP(50) = 0
      BNRTSPC(7) = 55.0  ;   MDPCST(7) = 755;    MDPIPE(7) = 25
      BRKFH(7) = 0.2909;     MBSCST(7) = 180;    MDPIPE(7) = 2
      MSLP(7) = 23000
      MTRCST(7) = 200;                  MBSEPMH(7) = 10
C
C * * ACCESSORIES 2  WITHOUT LIFE LIMITS * *
C
      MOT(51) = 1000000
      R(51) = 1.0
      ALOC(51) = 0.0
      SHP(51) = 2.0
      JSCL(51) = 338
      JSLP(51) = 0
      BNRTSPC(8) = 0.0;      MDPCST(8) = 124;    MDPIPE(8) = 0
      BRKFH(8) = 1.7179;     MBSCST(8) =   0;    MDPIPE(8) = 1
      MSLP(8) = 0
      MTRCST(8) = 0;                    MBSEPMH(8) = 10
C
C
C
      GO TO 9900
 9999 STOP
      END
```

```
C    GAMF -- REV APRIL 1971
* HONEYWELL TIME SHARING APPLICATION
*        ******************GAMMA FUNCTION*************************************
      FUNCTION GAMF(XPL1)
      DIMENSION A(9)
      DATA A/1.0,-0.577191652,.988205891,-0.897056937,.918206857,
     & -0.756704078,.482199394,-0.193527818,.035868343/
    1 X=XPL1+1.0
      TEMP=1.0
      TMP=XPL1
      IF(X.GT.1.0) GO TO 101
      IF(X.LT.0.0) GO TO 201
      GO TO 301
  101 N1=X
      DO 121 J1=1,N1
      TMP=TMP-1.0
  121 TEMP=TEMP*TMP
      GO TO 301
  201 N1=1.0-X
      DO 221 J1=1,N1
      IF(TMP) ,241,
      TEMP=TEMP/TMP
  221 TMP=TMP+1.0
      GO TO 301
*        ******************X=0 OR NEGATIVE INTEGER*****************************
  241 GAMF=0.
      GO TO 5001
C  CHANGED TO ELIMINATE NEED FOR CALL TO CLPLX***
  301 TMP=TMP-1.0
      GAMF=TEMP*(((((((A(9)*TMP+A(8))*TMP+A(7))*TMP+A(6))*TMP
     & +A(5))*TMP+A(4))*TMP+A(3))*TMP+A(2))*TMP+A(1))
 5001 RETURN
      END
```

VII. Program Variables

The program variables used in OMENS III are alphabetized and listed below with a brief explanation of each immediately following the variable.

ALOC(J) - Weibull location parameter; in most cases this parameter will be zero.

AMONREM - screen interval defined in equivalent months of life remaining.

BENRTSPC - initial base engine NRTS percent.

BERKFH - initial base level engine removals per 1000 flying hours.

BMHCST - base man-hour cost.

BNRTSPC(M) - base level initial NRTS percent by module.

BOTTOM - total NRTS alone plus total NRTS with engine plus total base removals for each module.

BRKFH(M) - base removals per 1000 flying hours.

DCONVR - conversion factor for changing months of utilization into daily demand rate.

DEPPC(M) - depot level removal percent by module.

DLCMDDR(M) - depot life cycle module daily demand rate.

EAFH - engine average flying hours.

EANRTS - engine average NRTS rate.

ELCBASE - engine life cycle base removals.

ELCDDR - engine life cycle daily demand rate.

ELCNRTS - engine life cycle NRTS removals.

ENGINE - name of engine.

ENRTSPC - engine final NRTS percent (output).

ENRTSPCT - engine seed totals NRTS percent.

EPIPEQTY - engine pipeline quantity.

ERKFH - output engine removals per 1000 flying hours.

ERKFHT - engine seed total removal / 1000 FH.

ERTSPC - percent engine base removals.

FACMNRTS(M) - final life cycle NRTS alone (not Rule of X Policy by module.

FACMRTS(M) - final life cycle base removals remaining at base by module.

FACNRTSW(M) - final life cycle Rule of X Policy NRTS removals by module.

FKFH(M) - see average removals per 1000 FH by module.

FNRTS(M) - see average NRTS percent by module.

FNRTSPC(M) - final NRTS percent by module.

FRKFH(M) - base final removals per 1000 flying hours by module.

FRKFHC(M) - total final removals per 1000 flying hours by module.

FRKFHD(M) - depot final removals per 1000 flying hours by module.

FTIME - time in hours and minutes (in clock minutes).

I - a counter.

IAOBGTOT - seed total of MOBFNCST(M).

ICLOCK - clock for aging.

IDCR - integer value of variable DCONVR.

ILCMCST - engine and module grand total maintenance costs.

IMGTLCPC - engine and module grand total parts costs.

IMPIPCST - grand total pipeline costs for engine and module.

INDATA - name of data set being used (internal to program).

IOBFNAX - seeds total NGTOTRT.

IOBFNTOT - module grand total maintenance, pipeline, and parts costs.

IP - print indicator; long run = 0, short run - 1.

IPG - page number.

IRPTPRD - input report period width.

ISCRN - screen constant.

IUSDRUN - # of seed runs; counts up to ISMAX.

ISIMPRD - total number of simulation years in program run.

ISIMYRS - total # of simulation years.

ISMAX - total # of Seed runs done.

ISSCRN - integer value of the percent of MOT screen.

ITIME - machine-supplied time during program run.

IWS - integer working storage in warmup.

IXCST - seed total of ILCMCST.

IXPART - seed total of IMGTLCPC.

IXPIP - seed total of IMPIPCST.

J - part number.

JF(N) - number of first part in Mth module.

JJ - number of parts.

JPART(J) - removal code for parts.

JPMOT(J) - maximum operating time assigned by part.

JSCL(J) - Weibull scale parameter; this is similar to an actuarial life expectancy.

JSCR(J) - screen removal for part J.

JSCRT - grand total parts screened removals.

JSLP(J) - stock list price for part J.

JTLCPCST(J) - total life cycle parts cost for each part.

JTM(J) - MOT removal for part J.

JTMT - grand total parts max time removals.

JTOL - tolerance interval constant.

JTOLR(J) - tolerance removal for part J.

JTOLRT - grand total parts tolerance removals.

JTOTR(J) - total number of removals for part J.

JTOTRT - grand total parts removals for all causes.

JTPSCHD(J) - total scheduled part removals by module for the entire simulation period.

JTTF(J) - time til failure of part J.

JTTL(J) - time til life limit of part J.

JUDEP(J) - usage screened to depot removal for part J.

JUDEPT - grand total parts usage screened to depot removals.

JUSE(J) - usage removal for part J.

JUSET - grand total parts usage removals.

K - report period counter.

K1 - report period time.

K3 - time remaining this report period.

KK - # of report periods.

KPI - constant or percent indicator.

KLAST - last report period.

KPV(M) - screen for modules 1 through 8.

KS - 0 implies standard seed, 1 implies random.

KW - 1 implies warmup, 0 implies none.

LCMCST(M) - life cycle maintenance cost, both depot and base, by module.

LCMCSTL(M) - depot life cycle maintenance costs of modules returned to depot alone.

LCMCST(M) - base life cycle maintenance costs by module.

LCMCST3(M) - depot life cycle maintenance costs with Policy by module for modules returned to depot with engine.

LCST4(M) - total of LCMCST(M) and LCMCST3(M) by modules.

LCTECST - life cycle total engine maintenance cost for depot and base.

LCTMCST - total LCMCST(M) for all modules.

LCTMCST1 - modular totals of LCMCST1.

LCTMCST3 - modular totals for all LCMCST3(M).

LCTMCST4 - total of LCST4(M) for all modules.

LFCYC - life cycle period in years.

LTIME - time in clock seconds.

LXCMST - seed total life cycle maintenance costs.

LXCMST3 - seed total life cycle maintenance costs at depot.

LXCMST4 - seed totals of LXCMST and LXCMST4.

LXCST(M) - seed total life cycle maintenance costs by module.

LXCST1(M) - seed totals of LCMCST1(M).

LXCST2(M) - seed totals of LCMCST2(M).

LXCST3(M) - seed totals of LCMCST3(M).

LXCST4(M) - seed totals of LCMCST4(M).

LXECST - seed total engine life cycle maintenance cost.

M - module number, used as counter in DO loops.

MASCR(M) - seed screened totals by module.

MASCRT - seed totals for screened module.

MATM(M) - seed time totals by module.

MATMT - seed totals for module time removals.

MAUD(M) - seed U-Dep totals by module.

MAUDT - seed totals for U-Dep module removals.

MAUSE(M) - seed usage totals by module.

MAUSET - seed totals for usage module removals.

MBIPE(M) - base pipeline in days by module.

MBSCST(M) - module base maintenance cost.

MBSEPMH(M) - module base separation man-hours.

MDPCST(M) - module depot maintenance cost.

MDPIPE(M) - depot pipeline in days by module.

MGTLCPCS(M) - module grand total life-cycle parts cost for each module.

MINF - minimum JTTF(J).

MINL - minimum JTTL(J).

MJSCRT(M) - total JSCR(J) for all J in module M.

MJTMT(M) - total JTM(J) for all J in module M.

MJTOLRT(M) - total JTOLR(J) for all J in module M.

MJTOTRT(M) - total JTOTR(J) for all J in module M.

MJUDEPT(M) - total JUDEP(J) for all J in module M.

MJUSET(M) - total JUSE(J) removals for all J in module M.

MM - number of modules.

MMC - multiple module counter for engine.

MMM - module counter.

MNRTSWTH(M) - total Rule of X Policy removals by module.

MNRWTHTL - total MNRTSWTH(M) removals for all modules.

MOBFNCST(M) - total LCST4(M) plus MPIPCST(M) plus MGTLCPCS(M) for each module.

MOD(M) - module removal code.

MODSCR(M,K) - total modules removed due to screened out parts by module and by report period.

MODTML(M,K) - total time module removals for a single scheduled part by report period and by module.

MODTM2(M,K) - total time module removals (for at least one schedule part) by report period and by module.

MODTOTR(M,K) - total module removals for all causes by module and by report period.

MODULE(M) - name of module.

MODUSEL(M,K) - total usage module removals for a single part by report period and by module.

MODUSE2(M,K) - total usage module removals (for more than one part) by report period and by module.

MONUTR - monthly utilization rate in flying hours.

MOT(J) - input life limit for part J in either TOT or cycles as appropriate.

MPC - multiple parts counter for module.

MPIPCST(M) - total pipeline cost per module.

MR3 - # of "rule of 3" modules with removals.

MRTS(M) - module base removals remaining at base.

MRTST - total module RTS removals.

MRULE - X value for Rule of X Policy.

MSCHNRTS(M) - module scheduled NRTS.

MSCHNRTT - total module scheduled NRTS.

MSCR(M) - module screen.

MSCRN(M) - screen interval for the Mth module.

MSCRNRTS(M) - module screened removals by module.

MSCRNRTT - total of MSCRNRTS(M) for all modules.

MSCRT - total screened modules.

MSLP(M) - stock list price by module.

MTM(M) - module max time removal.

MTMT - total of module max time removals.

MTNRTS(M) - total NRTS removals, not Rule of X Policy, by module.

MTNRTST - total MINRTS(M) for all modules.

MTOTR(M) - number of modules removed this period.

MTOTRT - total number of modules removed.

MTPIPCST - total MPIPCST(M) for all modules.

MTRCST(M) - module transportation cost by module.

MTSCR(M) - total MODSCR(M,K) by module for all report periods.

MTTM1(M) - total MODTM1(M,K) by module for all report periods.

MTTM2(M) - total MODTM2(M,K) by module for all report periods.

MTTOTR(M) - total MODTOTR(M,K) removals for all report periods by module.

MTUSE1(M) - total MODUSE1(M,K) for all report periods by module.

MTUSE2(M) - total MODUSE2(M,K) for all report periods by module.

MUD(M) - module usage to depot removal.

MUDT - total MUD(M) for all modules.

MULTF - counter of multiple part failures.

MULTL - counter of multiple parts scheduled.

MUNRTS(M) - usage removals by module.

MUNRTST - total MUNRTS(M) for all modules.

MUSE(M) - module usage removals.

MUSET - total MUSE(M) for all modules.

MUSNRTS(M) - usage screened removals by module.

MUSNRTST - total MUSNRTS(M) for all modules.

MXGPCS(M) - seed total parts costs by module.

MXOKNRTS(M) - by module, total shipped to depot as part of the Rule of X Policy but not needing repair.

MXOKNRTT - total MXOKNRTS(M) for all modules.

MXPIP(M) - seed total pipeline costs by module.

MXPIPT - seed total pipeline costs.

MXSCHNRT(M) - by module, scheduled Rule of X Policy removals.

MXSCHNTT - total MXSCHNRT(M) removals for all modules.

MXSCRNRT(M) - by module, screened Rule of X Policy removals.

MXSCRNTT - total MXSCRNRT(M) for all modules.

MXTOT - seed totals for module removals summary.

MXTRAN - seed totals for transportation costs.

MXTRCST(M) - seed totals by module for transportation costs.

MXUNRTS(M) - by module, total usage Rule of X removals.

MXUNRTST - total MXUNRTS(M) for all modules.

MXUSNRTS(M) - by module, total usage-screen Rule of X removals.

MXUSNRTT - total MXUSNRTS(M) for all modules.

NBPIPE - engine base pipeline in days.

NBSCST - base engine maintenance cost.

NBTESTMH - engine base test man-hours.

NDPCST - engine depot maintenance cost.

NDPIPE - engine depot pipeline in days.

NENGBASE - engine base removals.

NENGNRTS - engine base removals that were NRTS as Rule of X Policy

NENGTOT - engine total removals.

NERC - engine removal code.

NGTLCPCS - total MGTLCPCS(M) for all modules.

NGTM1(K) - engine grand total single module removals by report period.

NGTM1T - total of NGTM1(K) removals for all report periods.

NGTM2(K) - engine removals by report period for more than one module with at least one scheduled module.

NGTM2T - total of NGTM2(K) removals for all K periods.

NGTOTR(K) - engine total removals; all causes by report period.

NGTOTRT - grand total NGTOTR(K) for all K periods.

NGUSE1(K) - engine usage removals by report period for a single module.

NGUSE1T - total engine usage removals for a single module.

NGUSE2(K) - total usage engine removals by report period.

NGUSE2T - total of NGUSE2(K) for all report periods.

NN - number of entries in JF array (equals MM+1).

NOBFNCST - complete engine total maintenance and pipeline costs.

NTRCST - engine transportation cost.

NSLP - engine stock list price.

NTPIPCST - engine total pipeline cost.

NXBASE - engine seed totals base costs.

NXBFN - seeds total base alone maintenance costs.

NXDEPO - engine seed totals depot costs.

NXPCST - seeds total parts costs.

NXPIP - engine seed totals pipeline costs.

NXTRAN - engine seed totals transportation costs.

PART(J) - name of Jth part.

PIPEQTYM(M) - pipeline quantity by module.

R(J) - ratio of TOT to EFH or to cycles per flying hour.

RFACTOR - R factor to convert ratios to engine flying hours.

RLCPSCHD(J) - total scheduled part removals by module for the life cycle.

SCL(J) - scale parameter for Weibull.

SCLE - part scale parameter.

SCRINEFH - screen converted to engine flying hours.

SDTYP - seed type (random or standard).

SEED - random number seed.

SIMYRS - number of simulation years for program run.

SHP(J) - Weibull shape parameter (or = 1) 1 implies exponential; 1 implies removal rates which increase with age.

TOP - total NRTS alone plus total NRTS with engine for each module.

TOTPC(M) - total percent removals for cause repaired at depot.

TTF - time til failure.

XDATE - calendar date by month, day, and year.